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FIRST ANNUAL REPORT

OF THE

STATE DEPARTMENT OF HEALTH

OF

MASSACHUSETTS.



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FIRST ANNUAL REPORT
OF THE
STATE DEPARTMENT OF HEALTH
OF
MASSACHUSETTS.

For the fiscal year ending Nov. 30, 1915, the State Department of Health was constituted as follows: —

Commissioner of Health, ... ALLAN J. McLAUGHLIN, M.D.

PUBLIC HEALTH COUNCIL.

ALLAN J. McLAUGHLIN, M.D., *Chairman*.

DAVID L. EDSALL, M.D.

GEORGE C. WHIPPLE, S.B.

JOSEPH E. LAMOUREUX, M.D.

WM. J. GALLIVAN, M.D.

WM. T. SEDGWICK, Ph.D.

JOHN T. WHEELWRIGHT.

REPORT OF THE PUBLIC HEALTH COUNCIL.

In accordance with the provisions of chapter 792 of the Acts of 1914, Governor Walsh made the following appointments to the Public Health Council on Dec. 12, 1914: —

Chairman. — The Commissioner of Health is a member of the Public Health Council, as provided by section 3 of the above-named chapter, and at its first meeting, on Dec. 12, 1914, the Council voted that Dr. Allan J. McLaughlin, appointed as Commissioner of Health by Governor Walsh, be also made chairman of the Public Health Council. Dr. McLaughlin bears the rank of surgeon of the United States Public Health Service, and, at the request of the Governor, was granted a leave of absence from the service by the United States government in order that he might take up the duties of Commissioner of Health.

Member, Term to expire May 1, 1918. — David L. Edsall, M.D., Chief, East Medical Service, Massachusetts General Hospital. Dr. Edsall's first term expired May 1, 1915, at which time he was reappointed for a period of three years.

Member, Term to expire May 1, 1918. — J. E. Lamoureux, M.D. Dr. Lamoureux's first term expired May 1, 1915, at which time he was reappointed for a period of three years.

Member, Term to expire May 1, 1917. — Wm. T. Sedgwick, Ph.D., Professor of Biology and Public Health, Institute of Technology.

Member, Term to expire May 1, 1917. — George C. Whipple, S.B., Professor of Sanitary Engineering, Harvard University.

Member, Term to expire May 1, 1916. — Wm. J. Gallivan, M.D.

Member, Term to expire May 1, 1916. — John T. Wheelwright, LL.B. Mr. Wheelwright was appointed to fill the unexpired term of Dr. M. J. Rosenau, who was appointed to the Council on Dec. 12, 1914, but who resigned Jan. 27, 1915, in order to accept the position of director and pathologist of the Division of Biologic Laboratories of this Department.

From the time of the appointment of the Public Health Council to the end of the fiscal year, Nov. 30, 1915, twenty-seven formal meetings were held, and in addition numerous committee meetings. The slate of standing committees of the Council is as follows: —

Sanitary Engineering (including Housing and Rural Hygiene). — Professors Whipple and Sedgwick, Dr. McLaughlin and Mr. Wheelwright.

Preventive Medicine and Hygiene. — Drs. Edsall, Gallivan, McLaughlin and Lamoureux.

Foods and Drugs. — Professor Sedgwick, Drs. Gallivan and Lamoureux, and Mr. Wheelwright.

Finance, Law and Demography. — Dr. McLaughlin, Professor Whipple, Dr. Gallivan and Mr. Wheelwright.

In accordance with section 2, chapter 792 of the Acts of 1914, at a meeting of the Public Health Council on Jan. 11, 1916, the Commissioner of Health submitted to the Council a report of the work of the Department for the fiscal year 1915, together with recommendations for legislation, and it was voted that this report be approved and adopted as the report of the State Department of Health for the fiscal year 1915.

REPORT OF THE COMMISSIONER OF HEALTH.

In accordance with chapter 792 of the Acts of 1914, which follows, the undersigned was appointed by the Governor as Commissioner of Health and began his duties as such Nov. 2, 1914. This act provides for the abolition of the State Board of Health and the substitution therefor of a State Department of Health.

ACTS OF 1914, CHAPTER 792.

AN ACT TO CREATE A STATE DEPARTMENT OF HEALTH AND TO AMEND THE PUBLIC HEALTH LAWS.

Be it enacted, etc., as follows:

SECTION 1. There is hereby created a State Department of Health which shall exercise all the powers and perform the duties now conferred and imposed by law upon the state board of health. The state department of health shall consist of a commissioner of health and a public health council. There shall also be directors of divisions, district health officers and other employees as hereinafter provided.

SECTION 2. The commissioner of health shall be appointed by the governor, with the advice and consent of the council, and he shall be a physician skilled in sanitary science and experienced in public health administration. The term of office of the commissioner of health shall be five years. He shall receive an annual salary of seventy-five hundred dollars and shall devote his entire time to his official duties. The commissioner of health shall be the administrative head of the state department of health. His powers and duties shall be to administer the laws relative to health and sanitation and the regulations of the department; to prepare rules and regulations for the consideration of the public health council; and, with the approval of the public health council, to appoint and remove directors of divisions, district health officers, inspectors and other necessary employees, and to fix their compensation, subject to the approval of the governor and council, within the limitations of appropriations therefor. Directors of divisions and district health officers shall be exempt from civil service regulations. The commissioner of health shall submit annually to the public health council a report containing recommendations in regard to health legislation; and he shall perform all executive duties now required by law of the state board of health and such other duties as are incident to his position as chief executive officer. He may direct any executive officer or employee of the state department of health to assist in the study, suppression or prevention of disease in any part of the commonwealth.

SECTION 3. The public health council shall consist of the commissioner of health and six members, hereinafter called the appointive members, at least three of whom shall be physicians, and who shall be appointed by the governor, with the advice and consent of the council. Of the members first appointed, two shall hold office until the first day of May, in the year nineteen hundred and fifteen, two until the first day of May, in the year nineteen hundred and sixteen, and two until the first day of May, in the year nineteen hundred and seventeen, and the terms of office of the said members thereafter appointed, except to fill vacancies, shall be three years. Vacancies shall be filled by appointment of the governor, with the advice and consent of the council, for the unexpired term. The public health council shall meet at least once in each month, and at such other times as they shall determine by their rules, or upon the request of any four members, or upon request of the commissioner of health. The appointive

members shall receive ten dollars a day while in conference, and their necessary travelling expenses while in the performance of their official duties. It shall be the duty of the public health council to make and promulgate rules and regulations; to take evidence in appeals; to consider plans and appointments required by law; to hold hearings; to submit annually to the general court, through the governor, a report, including recommendations as to needed health legislation; and to discharge other duties required by law; but it shall have no administrative or executive functions.

SECTION 4. There shall be in the state department of health such divisions as the commissioner of health may, with the approval of the public health council, from time to time determine. The commissioner of health shall appoint and may remove, with the approval of the public health council, a director to take charge of each division, and shall prescribe the duties of such division. The compensation of directors of divisions shall be fixed by the commissioner of health, within the limits of appropriations therefor, and subject to the approval of the governor and council.

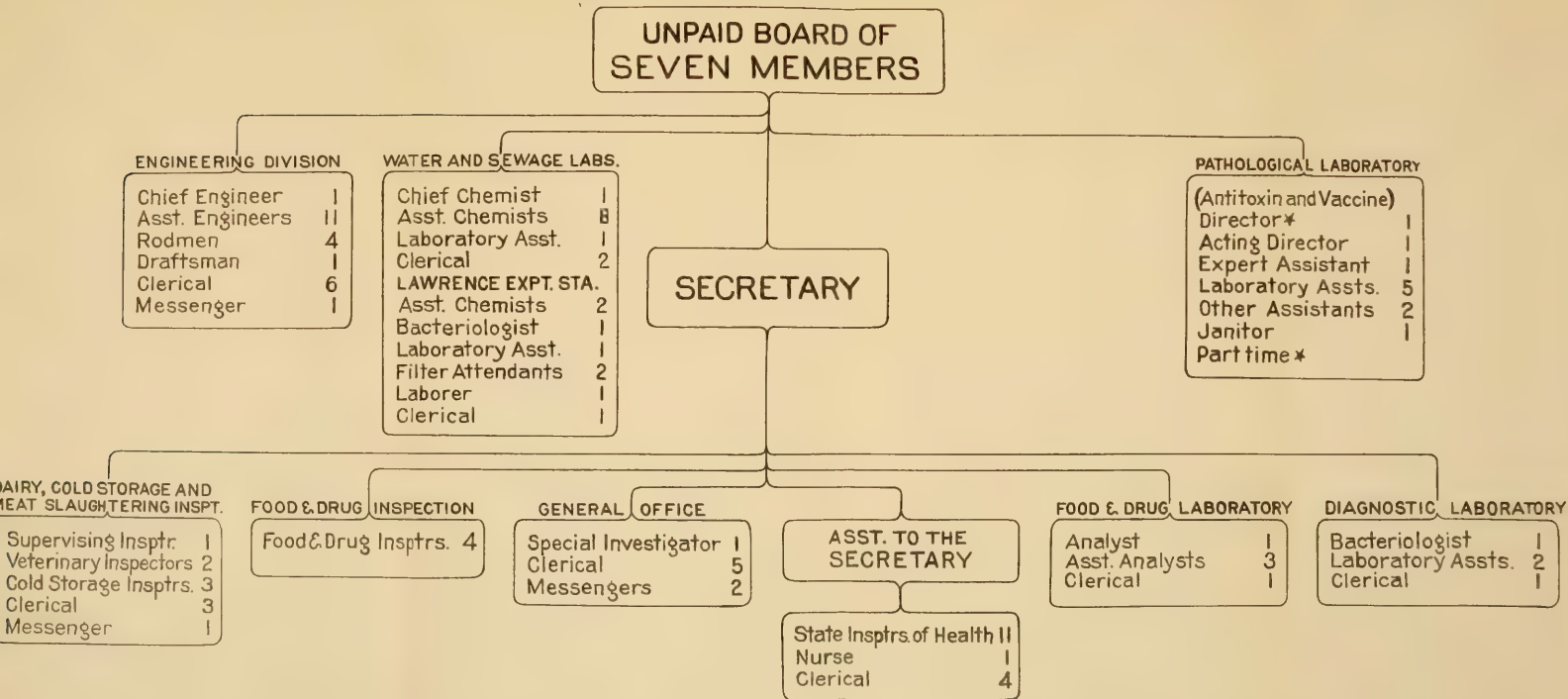
SECTION 5. The commissioner of health, with the approval of the public health council shall, from time to time, divide the state into eight health districts and shall appoint and may remove a district health officer for each district, with the approval of the public health council, at a compensation, subject to the approval of the governor and council, not exceeding thirty-five hundred dollars a year. The district health officers shall not engage in any other occupation and shall give their entire time to the performance of their duties. The commissioner of health may, from time to time, order two or more of said district health officers to work in one district in order to study, suppress or prevent disease. Each district health officer shall have all the powers and perform the duties now provided by law for inspectors of health and further shall, under the direction of the commissioner of health, perform such duties as may be prescribed by, and shall act as the representative of the commissioner of health and under his directors shall secure the enforcement within his district of the public health laws and regulations. Said district health officers shall be graduates of an incorporated medical school admitted to practice in the commonwealth, or shall have had at least five years' experience in public health duties and sanitary science.

SECTION 6. For carrying out the purposes of this act there shall be appropriated for the purposes of the state department of health, over and above the amount already appropriated for the state board of health for the year nineteen hundred and fourteen, the sum of ten thousand dollars.

SECTION 7. Present employees shall be continued in office until their successors are appointed and qualified, or until removed by the commissioner: *provided, however*, that no employee shall be removed who was appointed, or is now employed, under the provisions of the civil service laws and regulations, other than for cause, except division heads and district health officers who shall be appointed as hereinbefore provided.

SECTION 8. Sections one, two and three of chapter seventy-five of the Revised Laws and all other acts and parts of acts inconsistent herewith are hereby repealed. [Approved July 7, 1914.]

ORGANIZATION OF STATE BOARD OF HEALTH – JULY 7, 1914.



The State Board of Health which was thus abolished was organized as follows: —

An unpaid Board of seven members who possessed all executive and administrative authority.

A secretary, with no administrative or executive authority, except as delegated to him by the Board, but who presumably carried out the orders of the Board.

An assistant to the secretary whose activities seem to have been ill-defined and not in accordance with his title, but who seemed to be in charge of eleven part-time medical inspectors of health.

An engineer, and what was in effect an engineering division under his charge.

A pathologist in charge of a laboratory producing the diphtheria antitoxin and vaccine, at Forest Hills.

An analyst of food and drugs in charge of a laboratory for examination of samples of food and drugs at Room 501, State House.

A chemist in charge of the sewage experiment station at Lawrence and of the water and sewage laboratory, Room 502, State House.

A supervising inspector in charge of dairy, slaughtering and cold-storage inspection, with an office and clerical force at 1 Beacon Street, and five inspectors.

Four food and drug inspectors, under the general control of the secretary.

A bacteriological laboratory for diagnostic purposes, with a bacteriologist in charge.

A general office with the secretary in charge and a clerical force for files, records, financial details and miscellaneous activities which did not come under any of the units mentioned above.

The organization is shown graphically by Diagram No. 1.

The law provided for a Commissioner of Health who "shall be the administrative head of the department." It was further provided that the Commissioner of Health "shall perform all executive duties formerly required by law of the state board of health and such other duties as are incident to his position as chief executive officer." The framers of the law, in other words, desired to make responsible one full-time official "skilled in sanitary science and experienced in public health administration" instead of an unpaid part-time Board of seven members.

The intent of the law is further shown in section 4, which provides that "there shall be in the state department of health such divisions as the commissioner of health may, with the approval of the public health council, from time to time determine." This was intended obviously to place proper responsible heads in charge of clearly defined divisions in which should be grouped the various scattered units formerly operating independent of any executive control except such as could be exercised by the former unpaid part-time Board.

To meet the needs of the Department in its reorganization into divisions, the writer made the following suggestions which were approved by the Public Health Council:¹—

DIVISION OF —	Director.	Salary.
Administration, ...	- -	-
Communicable Diseases, ...	E. R. Kelley, M.D., . . .	\$4,000 00
Hygiene, ...	S. M. Gunn, ...	1,500 00 ²
Food and Drugs, ...	H. C. Lythgoe, ...	3,000 00
Sanitary Engineering, ...	X. H. Goodnough, ...	5,000 00
Water and Sewage Laboratories, ...	H. W. Clark, ...	4,000 00
Biologic Laboratories, ...	M. J. Rosenau, M.D., . . .	1,500 00 ²

Because of the wise provision of section 4, chapter 792, quoted on the previous page, it was possible to create the divisions most sorely needed first, leaving for future development other public health activities which ultimately must become divisions. For instance, in the Division of Hygiene, the work of infant mortality and medical inspection of school children is carried for the present, but undoubtedly the time will come when a Division of Child Welfare will be formed from these units.

There is also a possibility of improvement in the consolidation of some of the existing divisions when the time is ripe, especially the laboratory divisions. At present there are six laboratory units as given in the following table:—

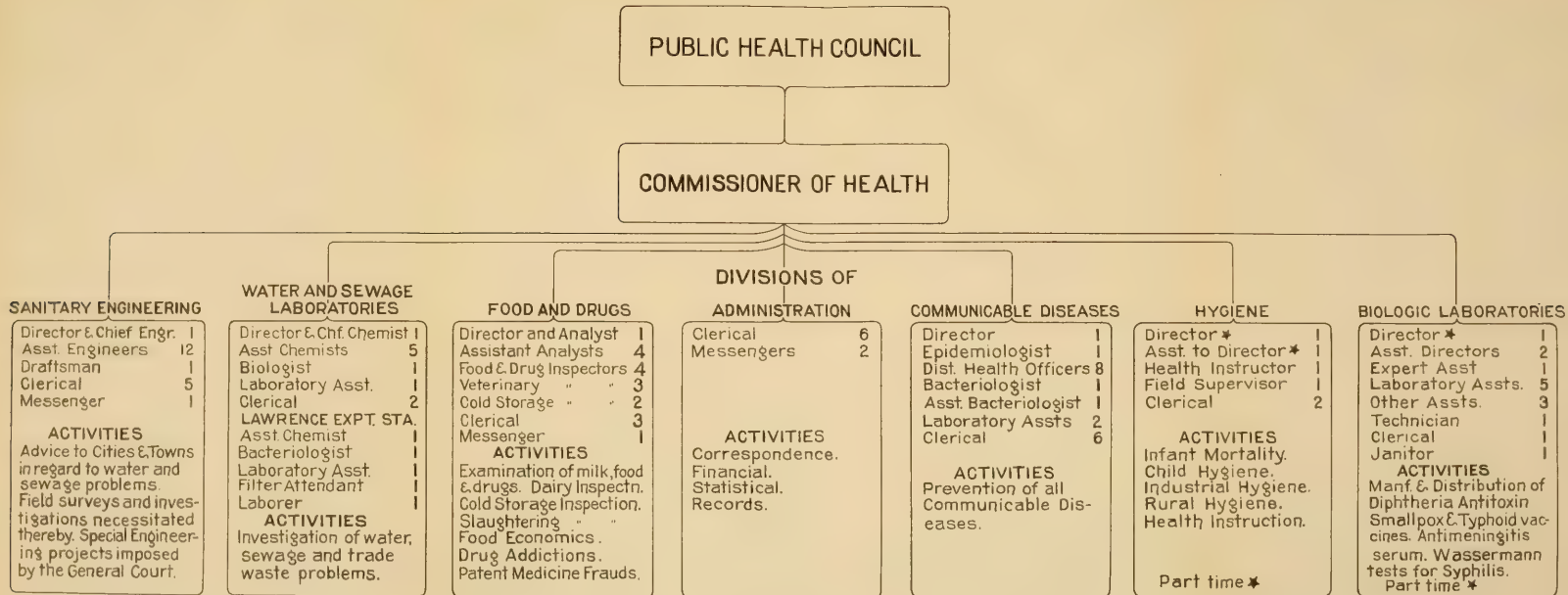
LABORATORY.	Location.
Water and Sewage Laboratory, ...	State House.
Lawrence Experiment Station, ...	Lawrence.
Diagnostic Laboratory, ...	State House.
Antitoxin and Vaccine Laboratory, ...	Forest Hills.
Wassermann Laboratory, ...	Harvard Medical School.
Food and Drug Laboratory, ...	State House.

Two possibilities for consolidation are worthy of consideration. First, to combine all laboratory units in one Division of Laboratories, and second, to divide the laboratory activities into two classes:

¹ See Diagram No. 2.

² Part time.

ORGANIZATION OF STATE DEPARTMENT OF HEALTH ~ NOV. 30, 1915.



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water and sewage laboratories (to be a subdivision of the Sanitary Engineering Division), and all other laboratories, with the exception of the Food and Drug Laboratory, to form a subdivision of the Division of Communicable Diseases. The whole question of laboratory readjustment has been referred to a special committee of the Public Health Council, and a solution of the laboratory problem may be expected within the next fiscal year.

DIVISION OF ADMINISTRATION.

Upon my arrival here I found that the first and most imperative need was to relieve the general office of the chaotic mixture of all sorts of public health activities with which it was struggling, and to establish a Division of Administration whose scope would be limited to the details of records and accounts.

In most departments, the Division of Administration or what corresponds to that division is in charge of a chief clerk, or, as in New York, there is in addition to the Commissioner of Health a deputy commissioner and a secretary to the Department under whom the administrative clerical work is presumably done. In my opinion there is no need, in Massachusetts, of either a deputy commissioner, a high-salaried secretary to the Council or a chief clerk. By apportioning the duties and responsibilities of correspondence, accounting, purchasing, care of property and filing among competent female clerks, it is possible for the Commissioner to supervise the work of records and accounts by giving a short time each day to this work.

I believe that there is a double advantage in this system. The salary of at least two high-priced men is saved, and the Commissioner himself obtains a better grasp of financial details and a closer, more direct control of expenditures. The latter advantage more than compensates for the short time given each day to the work, and for the present at least, I do not consider there is any need for additional direction in the Division of Administration. A female clerk, who is an expert stenographer, is acting as secretary to the Council in a very efficient manner at a salary of \$1,080 per year, whereas a male secretary to the Council would demand at least \$2,000 per year and probably require stenographic and typing assistance as well.

In order properly to safeguard public property and to secure economical purchasing, it was necessary to initiate certain well-known forms, which for some reason were not being employed.

Experience has taught that in an efficient department central buying is a necessity. It is a very careless procedure to permit individuals or officials to buy direct, letting the bills come into the central office

as they may. This encourages extravagance, is likely to produce deficits in appropriations, and the executive officer who permits such loose methods cannot know what obligations are outstanding. The practice of indirect buying which was in use has been stopped, and I have instituted a system which corrects this defect. The plan is as follows: —

A director of a division who requires material of any sort makes out his requisition on the central office, retaining a copy. From this request the central office makes a purchase order on the merchant, person or firm furnishing the supplies, a copy being retained in the central office and a copy being sent back to the director of the division who made the requisition. This copy of the purchase order is checked by the director of the division as to quantity and condition, and upon this checked order the bill is paid.

Property Return.

In every well-regulated business, all property is in the custody of some responsible individual who must make an inventory or property return of all property at least once each year. All property purchased, when turned over to division chiefs, should be charged to them and their receipt taken therefor.

The lack of a property return was probably due to the lack of central buying. I caused an inventory to be made of State property in the various divisions, and hereafter once each year a property return will be made by each director for his division. Property turned over to directors of divisions is now charged to their property return and they must certify to the existence or disposition of such property once each year.

An effort was made to cut off useless expenditures, and a notable saving in money expended for medical journals, books and binding was effected. It is not good policy for a health department to attempt to compete with large libraries. Complete files of all foreign medical journals may be obtained from the excellent libraries in Boston. It is therefore unnecessary for the Department to subscribe for these expensive publications, and unjustifiable to spend money for binding an incomplete file of such journals, when the use of the complete files can be readily obtained without cost to the Department.

Many other minor changes in office administration were made to facilitate the distribution and action upon routine mail, and for the simplification of the filing system.

The central buying system is in satisfactory operation, but much remains to be done in order to secure greater economy in buying sup-

plies. I see no reason why supplies which aggregate hundreds and in some instances several thousand dollars' worth should not be bought on contract. Therefore, I have given orders to secure competitive bids, with a view to securing contracts for such supplies.

I believe that money appropriated for a specific purpose should not be employed for any other purpose, and conversely I do not believe that money appropriated for the general expenses should be used for any work which has its own special appropriation. There should be a penalty, in my opinion, upon any director of a division who incurs a deficit. Estimates should be made with sufficient accuracy so as to cover the ordinary average work of the year. There should be an emergency or contingent fund to be drawn upon only for emergency or exigency which could not have been foreseen, as large epidemics or other unusual occurrences.

How Money should be spent.

How much money should be spent by a State Department of Health in its work of preventing disease among and maintaining the health of the people? Surgeon Carroll Fox, United States Public Health Service, has had exceptional experience in the study of health departments. He has stated that not less than 2 per cent. of the States' annual appropriations should be allotted to the health departments. In Massachusetts this would mean that the appropriation for the State Department of Health should be at least \$360,000, or about 10 cents per capita annually. Appropriations for the Department in round figures since 1910 have been made as follows:—

YEAR.	Amount.
1910, ...	\$160,000 00
1911, ...	176,000 00
1912, ...	187,000 00
1913, ...	198,000 00
1914, ...	195,000 00
1915, ...	209,000 00
1916 (amount requested), ...	220,000 00

This is very much less than the amount recommended by Surgeon Fox as a minimum. I believe that the State Department of Health should receive not less than 2 per cent. of the total State appropriations, but this idea is one to be developed gradually.

I believe that the first duty of the new Department was to make sure that the money (about \$200,000) annually appropriated was being properly spent, and that an adequate return in life saving and disease prevention was being secured before attempting to obtain greatly increased appropriations. This has been my constant care throughout the year, and although the total amount expended was only slightly in excess of the previous year, there were many readjustments of expenditure. Money saved in general expenses was applied to the work of the new Division of Hygiene. The Wassermann Laboratory was established, two new directors of divisions and an epidemiologist were employed, and increased work was done in all of the divisions.

Work in health departments should be adjusted among the factors in the total mortality according to the relative weight of the factors. Money should be expended in proportion to the relative weight of the factors. The relative weight of the factor is determined by the number of deaths due thereto, the amount of economic loss occasioned thereby, and the feasibility of prevention and reduction. The table on page 11 shows the chief factors in Massachusetts mortality which can be classed as more or less preventable. I have charged each of these items to one of the divisions, and the director of that division understands that such items constitute his problem. He is entirely responsible although he will receive assistance from other division chiefs in certain phases of his problem. The table contemplates over 40,000 more or less preventable deaths. Of this number, 25,000, or 62 per cent., have been charged to the new Division of Hygiene as its particular problem.

It has been said that public health is purchasable, and as health officers we will all subscribe to that statement. It is only fair to state, however, that a large part of the purchase price must be expended in education in personal hygiene, or, as we call it in Massachusetts, health instruction.

I believe that a conservative estimate of the relative weight of that portion of the public health problem which for its solution depends upon education would not make less than 50 per cent. of the whole. In spite of this we have asked for the new Division of Hygiene only \$15,000, or about 7 per cent. of our total appropriation. This is manifestly only a modest beginning, and not less than \$30,000 should be appropriated for 1917 for child welfare and health instruction alone. While no direct recommendation for such increase is necessary at this time, the Public Health Council may very properly accentuate these facts, so that a recommendation next year will be better understood.

Chief Factors in the Mortality for Massachusetts (53,000 Deaths per Year).

FACTOR.	Deaths. ¹	Division charged with its Reduction.	Division co-operating in its Reduction.
Infant mortality, ...	10,000	Hygiene (child welfare),	Communicable Diseases.
"Wear and tear" diseases, circulatory and urinary systems.	12,000	Hygiene (health instruction).	Laboratories (Wassermann), Communicable Diseases.
Cancer, ...	3,500	Hygiene (health instruction).	-
Syphilis, ...	2,500 (?)	Communicable Diseases,	Laboratories (Wassermann), Hygiene (health instruction).
Pneumonia, ...	6,000	Communicable Diseases,	Hygiene (health instruction).
Tuberculosis, ...	5,500	Communicable Diseases,	Hygiene (health instruction).
Diphtheria, ...	600	Communicable Diseases,	Laboratories (antitoxin), Hygiene.
Measles, ...	300	Communicable Diseases,	Hygiene (health instruction).
Scarlet fever, ...	300	Communicable Diseases,	Hygiene (health instruction).
Typhoid fever, ...	280	Communicable Diseases,	Sanitary Engineering, Water and Sewage Laboratories, Hygiene.
Whooping cough, ...	240	Communicable Diseases,	Hygiene (health instruction).
Influenza, ...	200	Communicable Diseases,	Hygiene (health instruction).

¹ Round numbers.

DIVISION OF SANITARY ENGINEERING AND DIVISION OF WATER AND SEWAGE LABORATORIES.

The Engineering Division was in existence as a smooth running unit under the old State Board of Health. It is in charge of a highly efficient engineer, Mr. X. H. Goodnough, who also possesses executive ability of a high order.

The division has been operated together with the Water and Sewage Laboratories and the Lawrence Experiment Station, chiefly under appropriations for purity of inland waters and examination of sewer outlets.

The work of the Engineering Division has increased enormously because of the increase in requests for advice from cities and towns. The appropriations have not kept pace with this increase, as is shown by the following table: —

YEAR.	Appropriations for Purity of Inland Waters and Examina- tion of Sewer Outlets.	Number of Requests from Cities and Towns for Ad- vice.
1910, ...	\$50,000 00	139
1911, ...	50,000 00	176
1912, ...	50,000 00	149
1913, ...	52,000 00	211
1914, ...	52,000 00	273
1915, ...	52,000 00	222

Increase of appropriation, 4 per cent.; increase of work, 60 per cent.

The field work of the engineers in complying with these requests from cities and towns has increased to such extent that for three years the field force has been overtaxed. A larger sum for field engineering is undoubtedly necessary, but was not asked for in 1916 because the expenses of the Lawrence Experiment Station were reduced about \$3,000 and this amount is available for additional field work by the engineers.

A further readjustment of the expenses of the Water and Sewage Laboratory will probably be made to permit of a reduction in some of the chemical routine examinations and an increase in the bacteriologic examinations of public water supplies.

The splendid work of these two divisions in the past in safeguarding the public water supplies of the State is best expressed by the enormous reduction in typhoid fever as a typical water-borne disease, as given in the following table:—

Deaths from Typhoid Fever in Massachusetts per 100,000, 1896-1914.

1896-1900, ...	25.4
1901-1905, ...	18.0
1906-1910, ...	13.8
1911, ...	8.8
1912, ...	7.7
1913, ...	7.8
1914, ...	7.4

In nearly every instance public water supplies in Massachusetts are delivered unfiltered to the consumers. Twenty per cent. of the community is served with ground water, and about 80 per cent. is served with surface water. The excellent quality of these supplies is respon-

sible for the very low typhoid fever death rate. With a surface water supply and a rapidly growing community, the cost of safety is eternal vigilance. The enormous storage available is the greatest factor in safety, but under the conditions enumerated, close bacteriologic control over municipal supplies is necessary. To effect this, more bacteriologic examinations should be made.

The Division of Water and Sewage Laboratories is under the direction of Mr. H. W. Clark, an expert chemist and research worker of national reputation. In addition to controlling public water supplies, very interesting problems in trades' wastes are being solved in the laboratories, and very valuable research work has been done in regard to depth of sewage filters and activated sludge. These experiments are fully described in Mr. Clark's report.

DIVISION OF FOOD AND DRUGS.

Various units existed under the former State Board of Health which could be classified under the general heading of food and drugs. There was a food and drug laboratory with an analyst and three assistant analysts in the State House. There were four food and drug inspectors, under the control of the secretary. There was a meat slaughtering inspection and cold storage and dairy division with an office at 1 Beacon Street, in charge of which there was a supervising inspector with a clerical force and two veterinary inspectors, and a cold-storage inspection force of three inspectors.

These units were consolidated in the new Division of Food and Drugs. The analyst, Mr. Hermann C. Lythgoe, was placed in charge as director. This consolidation of activities made possible the elimination of the office at 1 Beacon Street and the position of supervising inspector, carrying with it a salary of \$2,500, was also abolished. The official who occupied this position was re-employed as a veterinary inspector at \$1,800, which made it possible to dispense with the services of one cold-storage inspector. By combining the two clerical forces it was possible to dispense with the services of one stenographer.

The saving of this consolidation was as follows: —

Difference between salary of supervising inspector and veterinary inspector, ...	\$700 00
Salary of cold-storage inspector, ...	1,400 00
Salary of stenographer, ...	1,000 00
Rent of office at 1 Beacon Street, ...	800 00
Miscellaneous office expenses, ...	200 00
	\$4,100 00

I consider it inadvisable to employ any additional inspectors in the Food and Drug Division unless they are capable of doing laboratory work. Laboratory analysts can be employed for the same or lower salaries than inspectors. There is no reason why a chemist or analyst should not be able to do inspection work, while an inspector can only be used in the field. The present system is faulty because of the difficulty in maintaining a proper adjustment between the field force and the laboratory. For various reasons the work is subject to fluctuations, and the analysts are at times overworked. If additional employees are authorized, these should be laboratory workers. They could then be used in the laboratory when work in the laboratory was heavy, and sent out on inspection duty when laboratory work was light.

I believe that a Division of Food and Drugs should contemplate a broader field than the mere examination of milk, food and drugs. The question of drug addictions, the misuse of so-called household remedies, the traffic in dangerous proprietary and quack medicines, all present fruitful fields for action. The importance of careful studies of food values and food economics, and of an educational campaign along these lines, is apparent to any one who takes the trouble to observe some of our national faults. The average family either wastes food with reckless prodigality, or buys the family supplies with little, if any, regard to a correct adjustment of the essentials of a proper ration.

The relation of a proper ration to health is very close, and many times ill health and disease are due to an ill-balanced ration costing as much or more than a properly balanced ration which would maintain the family in health. Studies have been commenced in the Division of Food and Drugs upon food values and food economics, and it is desirable to use the results in a campaign of education with the cooperation of the Division of Hygiene.

However, the present appropriation must be spent in the enforcement of existing laws, and if the division is to assume a broader attitude and take up these very necessary phases of the food and drug problem, either an increased appropriation for these special purposes or a change in the wording of the existing statutes will be necessary.

Mr. Lythgoe was known to be an expert chemist and analyst, and as the director of a division he has demonstrated that he is an efficient, energetic executive officer as well.

DIVISION OF COMMUNICABLE DISEASES.

This new division was created to embrace such work as was being done by the former State Board of Health in the suppression of communicable diseases and such additional work as seemed necessary or desirable. The proper direction of such a division requires the full time of a competent sanitarian, and such a man was secured in the person of Dr. Eugene R. Kelley, formerly Commissioner of Health for the State of Washington, who was appointed director of the new division.

As far back as 1912, \$5,000 had been appropriated for the employment of an epidemiologist, but for some reason the appointment was never made. On June 1, 1915, an epidemiologist was appointed and placed under Dr. Kelley's direction.

Section 5 of the act creating a State Department of Health provided for eight full-time health officers instead of the twelve part-time health officers formerly employed. In order to avoid politics and to place the appointments on a merit system, regulations were adopted by the Public Health Council governing these appointments. These regulations provided for a competitive examination, the details of which will be discussed more fully in the report of the Director of the Division of Communicable Diseases, which will be found in the supplement.

The Division of Communicable Diseases is charged with the reduction or eradication of communicable disease. Its largest problems are tuberculosis, pneumonia, syphilis, diphtheria, measles, scarlet fever, typhoid fever, whooping cough and influenza. Its organization consists of a director, an epidemiologist and clerical force, a diagnostic laboratory, and a field force of eight full-time district health officers. Very interesting details are being worked out to improve methods of graphic presentation of disease prevalence, compiling returns, following up statistical reports, and various other office routine methods.

The work of the Diagnostic Laboratory has increased enormously, about 12,000 examinations being made in 1914, and about 17,000 in 1915, an increase of over 40 per cent. This was done without increase of appropriation, but was accomplished by overworking the personnel. This condition must be met and relieved, and additional money is necessary for the diagnostic laboratory.

The field force of eight district health officers has been very active, because, in addition to their work in this division, they have been made general representatives of the State Department of Health in their districts and given authority and responsibility accordingly. They have acted as advisers to local boards of health, and to them and

to Dr. Kelley belongs the credit of establishing tuberculosis dispensaries in the cities and towns in the Commonwealth with a population of 10,000 or over. They have made a complete survey of the State in regard to the manner in which medical inspection of schools is being carried on, and they have executed a multitude of other duties with the maximum of efficiency and the minimum of friction. A great deal of Dr. Kelley's time and some of the time of the district health officers has been given to the investigation of the milk problem, the results of which are published in the report of the Milk Board.

A complete and interesting account of the work of this division is given in Dr. Kelley's report, and I will discuss only some of the most important problems in a general way.

Tuberculosis.

Certain general conditions affect our ability to deal with the tuberculosis problem. Poverty, alcoholism, bad housing and overcrowding are some of these potent though indirect factors in a general condition or environment most favorable to a high prevalence of the disease. Attacks on these conditions may be classed as indirect attacks upon tuberculosis. Our direct attack should follow three lines: —

1. Hospitalization of hopeless cases in the terminal months of their illness.

2. Establishment and maintenance of dispensaries.

3. Improvement of physique of children who are below par physically.

While taking an active interest in anything which will improve general conditions, we are attempting to follow out vigorously the direct attack upon tuberculosis along the lines mentioned above.

The effort to secure hospital facilities for the hopeless cases nearer home than the State sanatoria was necessary because of two reasons: —

1. Difficulty of retaining patients in the sanatoria during the terminal months of their illness because of the distance from home and friends.

2. Capacity of State sanatoria was overtaxed by second and third stage cases which should be cared for locally.

It is extremely desirable to provide accommodations near home for the hopeless cases, and if these cases are cared for locally, the State sanatoria will be available for that type of case in which sanatorium treatment is most effective, viz., in the incipient stage.

The administration of the excellent law providing for the establishment of hospitals, including tuberculosis hospitals (Revised Laws,

chapter 75, section 35, as amended by Statute 1906, chapter 365, Statute 1911, chapter 613, Statute 1912, chapter 151, and Statute 1914, chapter 647), had two serious defects: —

1. Small cities with a population of from 10,000 to 25,000 might have been required to build from 10 to 20 bed hospitals, which would be not only very expensive to run, but would possibly have inefficient medical service.

2. Still smaller towns with a population of from 1,000 to 10,000 would not be required to build hospitals or bear any share of the expense of caring for tubercular cases, although they have their share of tuberculosis as well as the larger cities and towns.

After a hearing and statement by the Commissioner of Health before the public health committee of the General Court, the following resolve was passed: —

Resolved, That the state department of health be authorized and directed to investigate with reference to the advisability of establishing county or district hospitals for the care and treatment of cases of tuberculosis, from cities and towns having less than fifty thousand inhabitants. Said department shall report the result of its investigation to the next general court on or before the second Wednesday in January, and shall accompany its report with such recommendations for legislation as it may consider to be advisable.

In accordance with this resolve a searching and complete investigation was made to discover the most economical arrangement in districts of communities under 50,000 population. Experience has shown that the most economical unit for a tuberculosis hospital should have from 50 to 75 beds, and the districts mapped out by the Department provide for hospitals about this size. A report, with recommendations, will be submitted to the General Court outlining the districts which may be formed of communities having less than 50,000 population.

The law providing for the establishment and maintenance of tuberculosis dispensaries in cities and towns of 10,000 population or over (Statute 1911, chapter 576, as amended by Statute 1914, chapter 408) has been enforced by the Department, and at the present time all such cities and towns are complying with this law.

A thorough and intensive survey of the entire State has been made to determine in what manner medical inspection of schools is being carried on in the various communities, as provided by chapter 502, Acts of 1906, under the supervision and direction of the following Board appointed by me on June 4, 1915, and assisted by the eight district health officers: —

Dr. WM. J. GALLIVAN, representing the Public Health Council.

Prof. S. M. GUNN, Director, Division of Hygiene, *Chairman*.

Dr. EUGENE R. KELLEY, Director, Division of Communicable Diseases.

Dr. WM. H. COON, District Health Officer, *Recorder*.

Chapter 502, Acts of 1906, provides for compulsory medical inspection of schools. In all towns, except one, and in seventeen cities, the school physician is appointed and serves under the local school committee; in one town and sixteen cities, the school physician is under the local board of health. Exclusive of Boston, about \$100,000 is spent annually in this work, which is done without central control or supervision.

The possibilities of medical inspection of school children in preventive medicine are not being realized as fully or as rapidly as is desirable. There is a lack of a central directing authority competent to ensure uniformity of methods and co-ordination of effort along the lines of prevention rather than the detection of disease. Our greatest hope for ultimate success in the suppression of tuberculosis, for instance, must lie in the prevention of its development in the child with a predisposition for or latent infection of tuberculosis.

Syphilis.

Syphilis as a public health problem has received careful consideration from this Department during the past year. This subject has been neglected in the past, although as a problem of preventable contagious disease, and in opportunity for life saving, prevention of blindness, insanity and pauperism, it is second only to tuberculosis.

Syphilis is a preventable disease. We have exact knowledge of its cause, its modes of transmission, its prevention and its cure, yet we are not able to say that it is being reduced. What is its relative importance as a public health problem? It is responsible for more deaths than diphtheria, typhoid fever, scarlet fever, measles, whooping cough and influenza combined, and it is probably responsible for from two thousand to three thousand deaths each year in Massachusetts. Syphilis seldom appears on a death certificate. Hidden away under a dozen technical titles are thousands of deaths really due to syphilis.

The economic loss due to syphilis is appalling. It increases enormously our expenses for the blind, pauper and insane. In Massachusetts one-fourth of the entire expenses of the State government are incurred in the care of its insane. That is, of an amount something over \$18,000,000, \$4,500,000 is expended in equipping and maintaining

the institutions under the State Board of Insanity. At least 10 per cent. of insanity is due to syphilis, a preventable and curable disease, so that the State of Massachusetts expends at least \$450,000 annually for syphilitic insane. Under these circumstances it would seem sound business policy for the State to expend some money in the prevention of syphilis.

We have in salvarsan a specific remedy, which, if used in the early stages of syphilis, not only cures the individual but prevents him from infecting others. With our exact knowledge of the cause of the disease and possession of a specific remedy, why do we not eradicate it? Three reasons may be cited which in themselves are sufficient to explain our failure to even reduce the ravages of syphilis: —

1. The prohibitive price of (and since the war, inability to obtain) salvarsan;
2. The natural desire for concealment and secrecy of the individual infected with a venereal disease which is looked upon as a social disgrace; and
3. Lack of knowledge of the prevalence of the disease, and exact methods of diagnosis.

Salvarsan is made in Germany and patented in the United States. Its price before the war was from \$3 to \$4.50 per dose. At present, owing to the war, it cannot be obtained from Germany.

I believe that United States patents were never intended to deprive the people of any State of a substance which is necessary for their health and welfare. I further believe that the State of Massachusetts would be within its rights in manufacturing or in some other way procuring salvarsan for free distribution to residents of Massachusetts, in view of the fact that it cannot be obtained from Germany. Salvarsan can be made by our chemists. It is being made now in England, Japan and Canada, and also in Philadelphia, Pa.

I believe it is the plain duty of the State government to solve this problem, and that an act should be passed providing for free salvarsan for residents of Massachusetts. The draft of such a bill will be prepared and submitted to the Legislature at the proper time.

Health officers can never expect to handle syphilis as an ordinary contagious disease. Placarding houses, quarantining cases, and other measures involving publicity are unthinkable in a disease involving social disgrace. No experienced health officer who hopes for results is foolish enough to attack syphilis in this way.

Reporting of disease is exacted for two reasons: first, to give knowledge of and control over cases in an infectious state; and secondly, for statistical information. The reporting of syphilis, giving patients'

names, should not be required, and the reporting by number should depend upon voluntary co-operation rather than compulsion. The lack of exact methods of diagnosis has been partially corrected by the establishment of a State Wassermann Laboratory for the diagnosis of syphilis. The Wassermann Laboratory of the State Department of Health, which commenced work June 1, 1915, is now examining over one thousand specimens each month.

I believe that whenever a physician reports the data of a case of syphilis, omitting the name and address, and submits a specimen of blood which is found positive in our laboratory, the State should send him the salvarsan free with which to treat the case. The number, or other distinguishing mark sent in by the physician in lieu of the name of the patient, should be replaced by a serial number given by the State Department of Health, and the physician then requested to make future reports or references under the serial number.

The Wassermann Laboratory was operated for six months in 1915 for something less than \$3,000, but to continue this very necessary work for the full fiscal year 1916 will require at least \$5,000. This amount has been included in the estimates for 1916.

I realize that syphilis is not a word to conjure with, but I do believe that in view of its great importance in loss of life, production of blindness and insanity, and enormous economic loss, Legislatures should pursue a liberal policy and spend considerable money in combating this great plague.

Some of our larger hospitals and dispensaries are doing splendid work in destroying the infection in the carrier of syphilis. Many other hospitals and dispensaries should pursue a more liberal policy. These other hospitals now refuse to admit syphilis in the early stages, although they admit aortitis, aneurism, locomotor ataxia, and other diseases which are really syphilis in a later stage.

As a compensation salvarsan should be furnished free to hospitals and dispensaries. The time to eradicate the infection of syphilis is in the early stage. The general public must be educated in the appalling results of neglected syphilis, and dispensaries, hospitals and private physicians should be encouraged and assisted in treating the early cases, without allowing them to become cases of locomotor ataxia, general paralysis, heart disease or apoplexy.

It is said that to advertise the marvelous effect of salvarsan, and to place it within the reach of the poor, is to put a premium upon vice and to absolve the syphilitic from the just punishment of his sins. As health officers let us be practical and consider syphilis as a public health problem, leaving the academic discussion of its moral and

social aspects to others. We may relieve the unfortunate sufferer from the punishment of his own misdeeds, but we are also preventing this punishment from falling upon women, children and other innocent victims. Thousands of cases are acquired innocently from syphilitics, and our plain duty is to prevent these infections by eliminating the carriers of the disease without regard to their social or moral status.

Thousands of prisoners and inmates of Federal, State and municipal institutions are discharged each year, and these are turned loose without much regard to their being carriers of disease. In Massachusetts I believe that every inmate of a public institution should be tested for syphilis, and not discharged from that institution until he or she has been properly treated and shown to be no longer capable of infecting others.

As a sanitarian and practitioner of preventive medicine I desire to accentuate especially the necessity of early treatment in syphilis. The cardinal principle of our preventive campaign must be proper treatment in the early stages. In the first and second stages of syphilis the spirochaetes are more easily reached and destroyed by salvarsan, hence the chances of complete cure are vastly better than if treatment is delayed. The important point in early treatment, from the health officer's view, is that the infection is destroyed, and open sores and lesions, which are practically certain to cause other cases, are prevented.

DIVISION OF BIOLOGIC LABORATORIES.

These laboratories are engaged in the making of certain biologic products and tests for the prevention, cure or diagnosis of some of the most important communicable diseases. The products and tests are free to citizens of the Commonwealth.

In the past year over 200,000 doses of diphtheria antitoxin were made and distributed. In order to determine the susceptibility or immunity of an individual to diphtheria, we now have the Schick reaction, a skin test, which is very valuable in saving antitoxin. Individuals shown to be insusceptible by the Schick test need not be treated with antitoxin. The laboratory is now prepared to demonstrate to physicians and health officers how to use and to interpret the Schick reaction.

There were 31,355 ampoules of typhoid prophylactic produced and distributed in 1915, an increase of about 6,000 over the amount produced and distributed in 1914.

There were 1,100 packages of antimeningitis serum distributed in

1915. This is a curative serum, but the laboratory is prepared to furnish it in larger quantity if cerebrospinal meningitis should increase after the war. A vaccine of distinct prophylactic value can be prepared at short notice for use as a protective inoculation if the necessity for this should arise.

There were 139,140 doses of vaccine virus made and 104,922 doses distributed in 1915. Owing to the prevalence of foot and mouth disease, it was difficult to obtain calves and unusual precautions were necessary. In order to start afresh and be certain that no infection with foot and mouth disease had occurred, it was necessary to destroy a large amount of stock vaccine. The package in which the vaccine virus is distributed has been improved, and the cost of the same lessened. The circular of instructions which accompanies each package has also been rewritten, and it is recommended that the incision or scratch method be used in place of the old method of scarification. Special care is taken and elaborate tests made to determine the purity and potency of the vaccine.

The Wassermann test is a complex technical method of diagnosing syphilis from a specimen of human blood. Its great value will be appreciated after reading the statement in regard to syphilis as a public health problem in another part of this report. In June, 1915, the Wassermann Laboratory was established, and at our present rate will make over 18,000 tests in the next year.

We were extremely fortunate in securing as director of the division, on a part-time basis, Prof. M. J. Rosenau of Harvard University, thus ensuring expert supervision of the highest type as to potency and purity of biologic products, accuracy of method, and interpretation of biologic tests. Professor Rosenau, besides being professor of preventive medicine and hygiene at Harvard University, was for many years director of the Hygienic Laboratory of the United States Public Health Service in Washington. As head of this laboratory Dr. Rosenau had charge of all measures taken by the Federal government to ensure potency and purity in biologic products.

Further details of the work of this division will be found in Professor Rosenau's report.

DIVISION OF HYGIENE.

Health officers are justified in being proud of the achievements in the prevention of disease and the reduction of the death rates which are recorded in recent years, due largely to official activity. We have now reached a point, however, where further progress demands the hearty support of the individual citizen, and a wider application of

the principles of personal hygiene by the individual citizen himself. This means education of the people in their obligations to their neighbors and in the simple gospel of disease prevention.

In this campaign we have enlisted the practicing physician as an educator in preventive medicine, and I am confident we may count on his earnest effort and loyal support. There are the great thousands, however, who never or rarely call a physician, and who furnish the bulk of infant and tuberculosis mortality.

I am sure that all practical health officers have found that the greatest defect in the average health organization has been the lack of a medium for carrying effective sanitary instruction into the home. To reach these people, two very effective agencies are in our hands, and great results may be obtained if these agencies are properly directed, so that uniformity of procedure and co-ordination of effort can be secured under a central authority. I refer to the possibilities of public health or visiting nurses and to the hygiene of school children. In view of the great reductions already effected in the mortality rates for tuberculosis, typhoid fever, diphtheria, and other diseases, largely due to official activity, it may be said in Massachusetts that further reductions will be in direct ratio to the number of women employed in public health nursing.

The successful visiting nurse requires, besides a knowledge of the prevention of disease, tact, patience, and kindly solicitude for the welfare of the poor. Compare the results possible in life-saving by the work of such a woman with the results obtained from the work of the male sanitary inspector at the same or even a larger salary.

When we consider the difficulty of carrying health instruction into the home, and the apathy, indifference, skepticism and ridicule with which the doctrines of disease prevention, however simple, are too often received, the prospect for speedy results is not encouraging. We must concede that this part of the health officer's problem, in which success depends upon the voluntary co-operation of the individual, is much more difficult than that which may be solved by the passage and enforcement of laws and ordinances. The skepticism, the apathy, the passive and even active resistance displayed toward health instruction comes largely from an adult population whose early training did not include hygiene. The unteachable, unresponsive, I-know-it-all individual will probably persist in reaching the goal for which he is headed and will eliminate himself in a generation. The effective teaching of the principles of hygiene to the school children, especially in the lower grades, will develop an adult population in the next generation that will be neither apathetic nor skeptical, but will assist the health departments

of the future to teach hygiene where it will be most effective, viz., among the school children.

A very large part of the adult population, however, is not only teachable but hungry for the knowledge of how to live a little longer. Thousands of deaths due to what has been called the "wear and tear" diseases should have been postponed for years. Our efforts to show the necessity for hygienic living in preventing premature aging of our blood vessels and degeneration of vital organs should be unremitting, but here again, if we apply this instruction properly and effectively to the school child, we will not, in the next generation, face a constantly increasing death rate due to the "wear and tear" diseases.

To care for this problem of health instruction the new Division of Hygiene was created. Its scope will include infant mortality, child welfare, medical examination of school children, industrial hygiene, and health instruction in general. It will devote much of its energies to educational methods through literature, lectures illustrated by moving pictures and lantern slides, and personal instruction by its exhibits and health instructors. No special legislation can absolve this Department from its obligation "to take cognizance of the interests of life and health among the citizens of the commonwealth." This obligation does not exempt any age group. The hygiene of the child before and after entering school, and the hygiene of the worker from the time he leaves school, are as much our concern as the hygiene of all other citizens in the Commonwealth. We have, therefore, in our new Division of Hygiene, contemplated child welfare work, including the hygiene of school children and industrial hygiene, although certain phases of these two fields are covered by the work of other departments of the State government.

I believe that there should be but one State Department of Health, and that no State money should be expended for the prevention of disease unless under the supervision and control or by the advice of the State Department of Health. When other departments of the State government feel impelled to enter the field of hygiene or preventive medicine, they should consult with and ask the help of the State Department of Health rather than attempt to build up miniature health departments of their own.

The possibilities of this division in life-saving and disease prevention exceed those of all the other divisions combined. When we consider the possibilities in prevention of the 10,000 deaths included under infant mortality in Massachusetts each year, the possibilities in prevention of tuberculosis in the school child, the possibilities of "fitting the girl and boy to their job" upon leaving school, and the possibilities

in prevention of cancer and the so-called "wear and tear" diseases of middle life, we may appreciate the opportunities of the new Division of Hygiene.

In many of the important questions in the field of child hygiene now confronting the Division of Hygiene, little or nothing has been done by the State.

A uniform system of prenatal work should be extended to the point where proper obstetric advice and care are secured for the mother. This involves the question of adequate supervision of midwives and maternity hospitals. It is probably not feasible to eliminate midwives entirely and at once. Even if possible, by the application of drastic law, we should be prepared with some efficient substitute to take the place now filled by the ignorant midwife among the very poor. The midwife as an institution should not be legalized and perpetuated, as at best she can never be anything but a poor makeshift for good obstetric care. The extension of prenatal clinics, maternity hospitals, and of expert obstetrical advice and care to the poor is the answer to the midwife problem. The midwife will be eliminated in time by the competition of such prenatal clinics and maternity hospitals as place good obstetric advice and care within the reach of the poor.

There should be a close supervision of day nurseries and of other agencies which care for children from the nursing period to school age.

There should be an accurate survey and record of the physical and mental condition of every school child made at least once each year, and from these records proper advice given either to maintain this physical and mental standard or to better it, if necessary.

Imagine the possibilities of advice to children who are below par physically in preventing tuberculosis and increasing resisting power to all diseases! This advice would not always be heeded, but it at least could be given in all cases, and in many instances would be heeded. Special care should be exercised by the State in safeguarding the health and proper development, physically and mentally, of children in institutions, to ensure a sanitary environment, proper food and exercise, and proper habits of personal hygiene. There should be the same careful physical and mental survey as in the case of school children, and the special needs of defective children should be outlined at least once each year.

The same careful system of physical and mental records should be employed to advise the adolescent in selecting a vocation and in preventing the girl or boy from becoming a "square peg in a round hole."

A complete survey of the State has been made to determine what is being done in the matter of inspection of school children. These

records will form the basis from which a uniform effective system may be evolved. The law requiring medical school inspection is being carried out in the various communities according to the individual inclinations of the local authorities. In some cities and towns it is being efficiently done; in others, it is worthless as an instrument in preventing disease and improving the physical condition of the child.

By placing stress upon the enormous importance of the maintenance of health and the improving of the physical condition of the child in the prevention of diseases other than communicable, I do not wish to be misunderstood as underrating the importance of the communicable diseases. We must keep all the ground we have gained in the fight against tuberculosis, diphtheria and typhoid fever, and in syphilis we have a communicable disease problem, until this year untouched, which will demand our best efforts and which promises brilliant results.

I wish to accentuate further the fact that the campaign of health instruction, while primarily aiming to improve physical standards, to increase resisting power and to inculcate "safety first" habits of protection against disease, strikes at the heart of the communicable disease problem by decreasing the susceptible material by arming the susceptible with a knowledge of how to avoid infection.

The Division of Hygiene, although in existence but a few months, has carried out an extensive investigation of infant mortality, and now has knowledge of the conditions and mortality rates of 353 communities in the State. Special intensive studies are being made where the rates are highest. In Lowell a particular study was made of deaths of infants whose mothers were mill workers. The results of such studies as this will be followed by educational work in the locality studied.

In the month of November alone, forty lectures were given and over 5,000 persons reached in this direct manner. The lectures are illustrated by moving pictures and lantern slides.

Child welfare exhibits have been prepared and will be sent out in charge of health instructors. These exhibits have, besides panels with effective illustrations, utensils, clothing and materials for demonstrating to mothers how to care for their infants.

The division has had charge of the Monthly Bulletin for the past five months and has greatly improved this educational instrument.

A baby book entitled "The Baby and You" has been printed and is now ready for distribution. It is planned to place this book in the hands of every mother as soon as possible after the birth of her child.

Obviously the Division of Hygiene contains several divisions in embryo. The work of child hygiene will develop into a Division of Child

Welfare within a comparatively short time; industrial hygiene will also become a division in due time. In the meantime, these activities will be fostered and allowed to grow up in the Division of Hygiene until ready for independent existence as divisions.

The Department was particularly fortunate in securing for the director of the new Division of Hygiene Prof. Selskar M. Gunn of the Massachusetts Institute of Technology. Although on a part-time basis, Professor Gunn, because of his dynamic force, has been able to accomplish more than other available men would have accomplished on full time. To initiate the work of a new division, combining really the material for three divisions, and to launch it successfully on the very small amount of money available, required just the resourcefulness, the energy and excellent judgment which Professor Gunn has displayed.

HOUSING.

The subject of housing is so important and bears such a close relation to some of our greatest health problems that the following Board has been appointed to study the question in Massachusetts: —

Prof. G. C. WHIPPLE, representing the Public Health Council.

Mr. X. H. GOODNOUGH, Director, Division of Sanitary Engineering, *Chairman*.

Prof. S. M. GUNN, Director, Division of Hygiene.

Mr. A. D. WESTON, Division of Sanitary Engineering, *Recorder*.

This Board is now at work studying existing and proposed laws and ordinances and a report will be made late in 1916.

STATE EXAMINERS OF PLUMBERS.

At a meeting of the Public Health Council of the State Department of Health on July 6, 1915, it was voted to appoint Mr. David Craig as first examiner of the State Examiners of Plumbers, to fill the vacancy caused by Mr. Edward C. Kelley's resignation.

A brief report of the work carried on by the State Examiners of Plumbers will be found in the supplement.

MILK.

In Massachusetts the question of milk had been a subject of bitter controversy for years, and I was asked to take sides before I had been in office one month. It was deemed inadvisable to make legislative recommendations until Massachusetts conditions had been studied one year under existing law. During the past year a comprehensive study of the milk problem has been made by the following Board: —

Dr. J. E. LAMOUREUX, representing the Public Health Council.
 Dr. E. R. KELLEY, Director of the Division of Communicable Diseases, *Chairman*.
 Mr. H. C. LYTHGOE, Analyst and Director of the Division of Food and Drugs.
 Mr. E. H. WILLIAMS, Assistant, Engineering Division, *Recorder*.

The above Board was appointed on March 29, 1915, and has been assisted in its investigations by the eight district health officers employed by the Department. It is believed that all available pertinent facts in regard to the milk problem have been secured by this Board, and their report, with the recommendations of the Public Health Council, will be published in the near future.

LEGISLATIVE RECOMMENDATIONS.

The following specific recommendations are submitted to the Public Health Council in regard to necessary health legislation:—

1. An act providing for district hospitals for the care and treatment of cases of tuberculosis from cities and towns having less than 50,000 inhabitants.
2. An act providing for the detail of a district health officer or other medical officer of the State Department of Health for duty with the State Board of Education for the purpose of supervising the medical inspection of school children.
3. An act authorizing the State Department of Health to manufacture or procure salvarsan, for free distribution to citizens of the Commonwealth.
4. An act relative to the production, distribution and sale of milk.

APPROPRIATIONS.

The appropriations for the year ended Nov. 30, 1915, as recommended by the Commissioner of Health in the annual estimates made under the provisions of section 26, chapter 6 of the Revised Laws, were as follows:—

For the general expenses of the Department, ...	\$36,400 00
For the inspection of food and drugs, ...	17,500 00
For the salary of the director of the Division of Food and Drugs, ...	3,000 00
For the production and distribution of antitoxin and vaccine, ...	24,000 00
For water supply and sewage disposal, ...	56,800 00
For the State Inspectors of Health, ...	37,500 00
For the salary of the director of the Division of Communicable Diseases, ...	4,000 00
For the salary of an epidemiologist, ...	3,500 00
For the maintenance of a diagnostic laboratory, ...	5,300 00
For slaughtering inspection and cold storage, ...	12,000 00
For the prevention of ophthalmia neonatorum, ...	500 00
For the State Examiners of Plumbers, ...	5,200 00
For printing the annual report, ...	4,000 00
Total, ...	<u>\$209,700 00</u>

EXPENDITURES.

The expenditures under the different appropriations for the year ended Nov. 30, 1915, were as follows: —

General Expenditures.

Appropriation, ...	\$36,400 00
Credit by transfer to other appropriations, by cash received from various sources and returned to State treasury, ...	3,201 83
	\$39,601 83
Salaries, ...	\$23,467 22
Traveling expenses, ...	1,502 93
Express charges, ...	110 11
Printing and binding, ...	4,155 10
Books and subscriptions, ...	446 45
Educational work and advertising, ...	2,164 41
Stationery, maps and blue prints, ...	799 63
Postage and postal orders, ...	2,438 15
Telephone and telegraph messages, ...	452 45
Typewriting supplies and repairs, ...	313 20
Laboratory supplies, ...	251 77
Sundry office supplies, ...	922 77
Health Council, per diem, ...	1,521 26
Extra services, ...	429 60
Messenger, ...	209 64
Rent, ...	200 01
Miscellaneous, ...	91 52
Total, ...	\$39,476 22

Expenditures under the Provisions of the Food and Drug Acts for the Year ended Nov. 30, 1915.

Appropriation, ...	\$17,500 00
Credit by transfer to appropriation for director of Division of Food and Drugs, and by cash received from various sources, ...	1,043 60
	\$18,543 60
Salaries of analysts, ...	\$6,056 26
Salaries of inspectors, ...	6,239 29
Salaries of office assistants, ...	1,100 00
Traveling expenses, ...	2,735 89
Purchase of samples, ...	423 29
Apparatus and chemicals, ...	886 33

Express, ...	\$10 94
Printing, ...	49 60
Books, maps and stationery, ...	430 46
Telephone and telegraph messages and postage, ...	134 25
Sundry laboratory supplies, ...	81 95
Typewriting supplies and repairs, ...	150 50
Services (cleaning laboratory), ...	143 00
Extra services, ...	85 83
Miscellaneous, ...	14 62
Total, ...	\$18,542 21

Expenditures for the Production and Distribution of Antitoxin and Vaccine for the Year ended Nov. 30, 1915.

Appropriation, ...	\$24,000 00
Transferred from extraordinary expenses, as authorized by the Governor and Council, ...	1,627 70
From 1914, balance to cover bills incurred during 1914, ...	6 20
Credit by cash paid to State treasury, account of scales returned, ...	6 88
	\$25,640 78

Salaries, ...	\$12,296 81
Apparatus, chemicals and laboratory supplies, ...	4,134 29
Traveling expenses, ...	47 44
Express charges and carting, ...	158 12
Books, stationery and typewriting supplies, ...	229 47
Printing, ...	429 09
Purchase of animals, ...	832 84
Horseshoeing and stable equipment, ...	10 40
Services of veterinary surgeon, ...	22 00
Food for animals, ...	3,546 18
Rental of telephone, messages and postage, ...	123 63
Extra services, ...	415 90
Water, gas, electric lighting and heating, ...	462 54
Labor and materials, ...	476 33
Ice, ...	128 45
Rent, ...	2,012 49
Miscellaneous, ...	314 16
Total, ...	\$25,640 14

For carrying out the Provisions of the Act to protect the Purity of Inland Waters, for the Examination of Sewer Outlets, and for the Examination of the Sanitary Condition of Certain Rivers and Water Courses.

Appropriation for the year ended Nov. 30, 1915, ... \$56,800 00

Salaries, including wages of laborers at Lawrence Experiment Station, ...	\$43,706 01
Apparatus and materials, ...	3,518 71
Traveling expenses, ...	3,913 11
Express charges, ...	1,622 78
Printing and binding, ...	356 37
Maps, blue prints and books, ...	214 50
Stationery, drawing materials and typewriting supplies, ...	1,497 35
Telephone, telegraph messages and postage, ...	208 45
Extra services, ...	12 00
Services, collection of samples and reading gauges, ...	721 45
Labor, ...	71 10
Rent, ...	150 00
Miscellaneous, ...	152 77
Total, ...	\$56,144 60

Expenses under the Provisions of the Act to provide for the Establishment of Health Districts and the Appointment of State Inspectors of Health (Chapter 537, Acts of 1907; Chapters 405 and 543, Acts of 1910; Chapters 603 and 609, Acts of 1911) for the Year ended Nov. 30, 1915.

Appropriation, ...	\$37,500 00
Credit by paid to State treasury, ...	170 56
	\$37,670 56

Salaries, ...	\$27,209 04
Traveling, ...	7,614 74
Express, ...	10 60
Printing, ...	398 37
Books and maps, ...	24 43
Postage, ...	615 19
Typewriting supplies, ...	153 58
Extra services, ...	671 38
Telephone and telegraph, ...	292 42
Office supplies, ...	282 43
Laboratory and experimental work, ...	366 87
Research field work, ...	18 36
Miscellaneous, ...	13 15
Total, ...	\$37,670 56

*Expenditures for the Maintenance of a Diagnostic Laboratory for the Year ended
Nov. 30, 1915.*

Appropriation, ...	\$5,300 00
Credit by received from Peter Gray, account of copper box (re- funded), ...	1 00
	\$5,301 00
Salaries, ...	\$4,094 41
Laboratory supplies, ...	435 14
Printing, ...	304 85
Stationery, ...	53 47
Mailing cases, ...	317 32
Office supplies, ...	38 25
Typewriting supplies and repairs, ...	4 95
Traveling, ...	2 24
Miscellaneous, ...	16 23
Total, ...	\$5,266 86

*For carrying out the Provisions of the Act relative to Slaughtering Inspection and
the Inspection of Food Products treated by Cold Storage.*

Appropriation for the year ended Nov. 30, 1915, ...	\$12,000 00
Credit by paid to State treasury, account of sale of branding outfits, ...	381 60
	\$12,381 60
Salaries, ...	\$9,690 58
Traveling, ...	2,136 81
Printing, ...	63 27
Branding outfits, ...	352 45
Stationery and office supplies, ...	21 35
Telephone and telegraph, ...	14 36
Postage, ...	55
Extra services, ...	25 00
Typewriting supplies, ...	4 25
Purchase of samples, ...	12 16
Miscellaneous, ...	4 10
Total, ...	\$12,324 88

For carrying out the Provisions of the Act relative to the Prevention of Ophthalmia Neonatorum (Chapter 458, Acts 1910).

Appropriation for the year ended Nov. 30, 1915,		\$500 00
Ophthalmia outfits,		\$500 00
Total,		\$500 00

A. J. McLAUGHLIN,
Commissioner of Health.

SUPPLEMENT.

DIVISION OF SANITARY ENGINEERING.

DIVISION OF SANITARY ENGINEERING.

DIRECTOR AND CHIEF ENGINEER, X. H. GOODNOUGH.

Dr. ALLAN J. McLAUGHLIN, *Commissioner of Health.*

SIR: — I have the honor to submit the following report of the Division of Sanitary Engineering for the year ending Nov. 30, 1915.

Respectfully,

X. H. GOODNOUGH,
Director and Chief Engineer.

WATER SUPPLY AND SEWERAGE.

The Department received during the year 224 applications for advice with reference to water supply, sewerage, sewage disposal and matters relating thereto. Of these applications, 54 were in relation to public water supplies, 90 to wells and springs, 22 to sources of ice supply, 35 to sewerage, drainage and sewage disposal, 4 to the pollution of streams, and 19 to miscellaneous matters.

WATER SUPPLIES.

Public water supplies were introduced during the year in the towns of Dartmouth, Groveland, Salisbury and Shrewsbury. The water supply of Groveland is obtained from the works of the city of Haverhill, that of Dartmouth from the works of the city of New Bedford, and the others are from independent sources. A new water district was established during the year in the town of Easton to supply the villages of South Easton and Eastondale. The supply is obtained from the works of the city of Brockton.

Of the 353 cities and towns in the State, 211, which contained by the census of 1915 a population of 3,528,769, are provided with public water supplies. The remaining towns, 142 in number, contained by the census of 1915 a population of 164,541.

The following towns, having by the census of 1915 a population in excess of 3,000, are not yet provided with public water supplies: —

Tewksbury,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5,265
Warren,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4,268
Templeton,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4,081
Somerset,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3,377
Auburn,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3,281
Westport,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3,262

Water supplies are greatly needed in most of these towns, especially in Somerset, Templeton and Warren, in which there are large villages dependent wholly for water for domestic purposes on wells and springs. The results of analyses of the waters of many of the wells in the thickly populated areas in each of the above towns indicate that practically all are very badly polluted and unsafe for domestic use.

There is also a considerable number of towns, having by the census of 1915 a population between 2,000 and 3,000, in many of which water supplies are very badly needed. These towns are the following: —

Sutton,	2,829
Seekonk,	2,767
Bourne,	2,672
Hanover,	2,666
Swansea,	2,558
Wilbraham,	2,521
Dighton,	2,499
Acushnet,	2,387
Wilmington,	2,330
Rehoboth,	2,228
Charlton,	2,213
Harwich,	2,179
Belchertown,	2,062
Georgetown,	2,058
Upton,	2,036

In many of the above-named towns the wells are badly polluted and a serious danger to the public health.

During the past year an examination has been made of the wells in the town of Rowley, which is not provided with a public water supply. The population is largely concentrated in the main village, and an examination of the mortality statistics in this village, made by the Department, has shown that typhoid fever has been excessively prevalent in this town for a period of twenty years or more and that cases have occurred from time to time at more or less frequent intervals in nearly all parts of the village throughout that period. The results of analyses show that the water of the wells in the thickly settled portions of this town is polluted by sewage, in many cases most seriously. At most of the dwelling houses in the village the water supply is obtained from a well on the premises, and the sewage is disposed of by discharging it into a vault or cesspool, also on the premises and usually at no great distance from the well. The ground on which the village stands is composed largely of strata of gravel and fine sand or clay, which extend to a considerable depth and are underlaid by a very fine sand and lower down by ledge. The water supply is usually obtained from wells averaging some 3 feet in diameter and 20 feet in depth, and, if dug to the average depth, they seldom fail, even in the driest years, since the level of the ground water beneath the village does not vary very greatly in height from year to year. The water obtained from these wells is derived from the rain-

fall, a portion of which sinks into the ground. As the town has no sewerage system, a large portion of the water which is withdrawn from the wells is returned to the ground in the form of sewage through the cesspools and other receptacles, and much of it evidently again finds its way to the wells.

There is no way of securing water which is safe for drinking from the ground in the thickly settled portion of this town, and for the protection of the public health a public water supply from some suitable source should be introduced at the earliest practicable time. With a proper public water supply, the present method of disposing of the sewage would probably not be objectionable and could be continued for many years, unless the population becomes more dense than is the case at the present time.

There have been numerous cases of typhoid fever in the village of Somerset also, and similar occurrences have taken place in Harwich and other villages where the density of population produces conditions such as those described in the town of Rowley.

Among the towns in which a decided effort has recently been made to secure a public water supply are Warren and Belchertown, places in which such supplies are greatly needed. In each town a large majority has voted repeatedly for the introduction of water, but a provision of the law which requires a two-thirds vote has prevented the carrying out of legislative acts granting the right to these towns to secure a public water supply. Considering the necessity of a public water supply in these and many other places, and the importance of a good water supply in the protection of the public health in communities of considerable size, it is unfortunate that a two-thirds vote is required for the introduction of a water supply system. The custom was introduced many years ago when the question of the success of a public water supply was considered to be a matter of considerable doubt. Experience has amply shown that a public water supply quickly becomes self-supporting in towns of such size as those under consideration, and the continuation of the requirement of a two-thirds vote for the introduction of such a supply seems now unnecessary and objectionable.

A further hindrance to the introduction of public water supplies by towns and districts results from the change from the former method of establishing a sinking fund for the payment of bonds issued for such purposes to the practice of issuing serial bonds, the effect of which is to require a much larger payment for interest and the retirement of bonds in the earlier years after the introduction of a water works system than was formerly the case. At the present

time, if a town issues bonds on a thirty-year basis at 4 per cent., the interest and bond payment together amount in the first year to $7\frac{1}{3}$ per cent., whereas the average amount needed for the payment of the bonds and interest, if carried out on the sinking fund basis of a fixed annual sum, would only be about $5\frac{3}{4}$ per cent. The serial bond method of payment, however, appears to be the more desirable one, at least in the case of the small towns, but the present law makes it necessary that one-thirtieth of the bonded indebtedness shall be paid off in each year from the time the construction of the works is begun. This provision is undoubtedly a desirable one in the case of many public works, but in the case of a public water supply a year is usually required in which to complete the works, and another year, and sometimes two years, usually elapses before the water has come into general use. As soon as a general use is established, the town or district finds itself in receipt of an income usually nearly or quite sufficient to care for the maintenance of the works and pay a part, if not all, of the interest and bond retirement requirements of the legislative act under which the works were built. Under these circumstances, there seems to be no good reason why a bond should be paid off in the first or second year at least after the construction of the works is begun. It merely means that the town has to borrow considerably more money than would otherwise be needed for the construction of its works, since provision must be made for the payment of a bond before the works are completed and of another one, or perhaps two, before they have come into general use. No public interest would be injured, while on the other hand a considerable advantage would accrue, if the first annual payment in the case of the original introduction of a water works were deferred for as much as three years after the construction of the works was begun.

INCORPORATED DISTRICTS FOR THE SUPPLY OF WATER.

Under the conditions existing in Massachusetts, it is usually impracticable when a town introduces a public water supply to extend the service to all the inhabitants of the town. The system is commonly restricted, in the beginning at least, to the most thickly settled portion of the town, usually the principal village. When a town contains two or more villages, as is often the case, it may not be practicable, on account of distance or difference in elevation, to extend the works to the secondary center without considerable expense. It furthermore often happens that a large percentage, if not a majority, of the inhabitants of the town live in scattered farmhouses in areas which would

not be supplied by works designed for the most thickly populated section, and, in consequence, it is often impracticable for the inhabitants of the thickly settled section to obtain a water supply through a vote of the town, however badly such a supply may be needed in that section. In such cases some other method than town ownership must be adopted if the water supply is to be obtained. Two methods have been employed in such cases; one, the introduction of works through a water company; and the other, the creation of a fire, water or water supply district, which constructs and owns the works. The number of water companies supplying towns in Massachusetts is not large; nevertheless there are 43 towns in which water is supplied by water companies, largely on account of the fact that the inhabitants of those portions of the town desiring water were unable to secure the two-thirds vote required for the introduction of the works by the town. The number of towns in the State in which fire, water and water supply districts have constructed works for similar reasons is 28.

It has also happened in several of these towns that, when a water supply became necessary in other villages than the one originally supplied, a second district has been created, and thus there are often two water or fire districts in the same town, each maintaining an entirely distinct system of water works supplying water from separate sources. Such an arrangement is objectionable from the point of view of municipal economy and may be objectionable in other ways. A notable case of the objections to such an arrangement has been brought to the attention of the Department during the past year.

Under the provisions of chapter 169 of the Acts of the year 1887, the North Easton Water Company was incorporated and authorized to supply the inhabitants of the town of Easton, or any part thereof, with water for domestic, manufacturing and other purposes, including the extinguishment of fires. This act contained a provision that the town of Easton, or the incorporated district therein known as the North Easton Village District, should have the right to take, by purchase or otherwise, the franchise, property, etc., of the water company and operate the works thereafter under the powers of a fire district, and the works are now owned and operated by the North Easton Village District. This district as established occupies a nearly rectangular area about $1\frac{3}{4}$ miles long in a northwesterly and southeasterly direction and a little less than $1\frac{1}{2}$ miles wide, located near the extreme northeastern corner of the town. It comprises an area of about $2\frac{1}{4}$ square miles, the total area of the town being 29.4 square miles. The northwesterly limits of the district are approximately

parallel to the northwesterly boundary of the town and only an average distance of about .25 of a mile therefrom. The extreme easterly limits of the district are .7 of a mile from the boundary of the city of Brockton.

In the year 1915 a second district was established within the town of Easton known as the South Easton and Eastondale Fire and Water District. This district comprises a section of the town about 5 miles long and averaging a little over 1 mile in width lying along the easterly border of the town adjacent to Brockton and West Bridgewater. Its northerly limit is about $2\frac{1}{4}$ miles south of the boundary between Easton and Stoughton, and this limit extends from the boundary of the North Easton Village District to the boundary line of the city of Brockton. The North Easton Village District is supplied with water from wells situated in the valley of a tributary of the Coweaset River within the limits of the district. The South Easton and Eastondale Fire and Water District is supplied from separate works through an extension of the pipes of the city of Brockton.

The arrangement of the two districts herein described leaves in the extreme northeasterly corner of the town of Easton an area about $2\frac{1}{4}$ miles long in a northerly and southerly direction and from $\frac{3}{4}$ to $1\frac{1}{2}$ miles in width which does not form a part of either district and is practically wholly cut off from the remaining portions of the town. This district, known as Unionville, is inhabited by about ninety families, and, in response to a petition of certain inhabitants thereof, the State Department of Health during the past year investigated the condition of the water supply in Unionville, as a result of which it was found that many of the wells in use were badly polluted, and the Department is informed also that many of them have failed during the dry seasons that have occurred in recent years. The best practicable plan of supplying this village with water cannot be determined without an engineering investigation. It is probable that a supply could best be obtained in connection with the works of the North Easton Village District, but it is possible to supply water to this locality from the works of the city of Brockton, and the village might be supplied from the works of the South Easton and Eastondale Fire and Water District, though the cost of a supply from the latter district would very probably be considerably greater than if water were obtained from the North Easton Village District, and the system would be less economical in other ways. In view of the circumstances, it is desirable that legislation be enacted which will enable the village of Unionville to secure a much needed general water supply.

PRIVATE WATER SUPPLIES.

The Revised Laws of Massachusetts provide that the State Department of Health shall have the general oversight and care of inland waters and of all streams and ponds used by any city, town or public institution, or by any water company or ice company as sources of water supply, and of all streams and water courses tributary thereto, and the Department is further empowered to cause examinations of such waters to be made to ascertain their purity and fitness for domestic use or their liability to impair the interests of the public or of persons lawfully using them, or to imperil the public health. It is finally provided that plans relating to the introduction of systems of water supply shall be submitted to the Department for its advice before the works are constructed. No provision whatever is made in these laws for the examination of private water supplies and none are examined, except in connection with investigations made by the Department for specific purposes, relating usually to questions connected with the investigation of causes of contagious disease. The examination of private water supplies is, consequently, left to the owner or occupant of the premises upon which the supply is situated. The number of public water supplies in the State of Massachusetts barely exceeds 200, while the number of private supplies probably exceeds 30,000 and may be greatly in excess of that figure.

The extension of the work of the examination of water supplies to all private sources, a question which is raised from time to time, is of course impracticable, except at great cost, and on the whole is probably unnecessary. There are certain classes of private supplies, however, to which it seems desirable in the interest of the public health that the oversight of the State should be extended. One of these is the water supplies of summer hotels and boarding houses and places of public resort, such as picnic groves, camp grounds, etc. The sanitary conditions of such premises can be looked after efficiently by the local boards of health, but such boards are not usually equipped with means for the proper investigation of the water supplies of such places. It not infrequently happens that the State Department of Health is requested to make examinations of the water supplies of camps and other resorts suspected of being the sources of communicable diseases, and a considerable number of such examinations has been made in past years. It would be much better, however, if the water supplies of such places were maintained under supervision at all times and the danger of diseases arising from such places avoided.

Another class of private water supplies somewhat intimately con-

nected with the public health comprises the supplies used in the washing of utensils on farms and at dairies from which the public milk supply is derived. The expense of a proper examination of a water supply is a considerable one and is often a more serious tax than a farmer or dairy owner feels able to incur. Examinations of many such sources have been made in the past at times of prevalence of contagious disease, and it would no doubt be much better if provision for such examinations were made by law and sources found to be dangerous improved or eliminated.

While the cost of such work would be considerable, it would not only aid materially in the further reduction of typhoid fever and similar contagious diseases, but would also no doubt be a material advantage to the State, especially in the case of summer hotels and boarding houses, since it would inform the public as to the safety or danger of the water supply of such places. Such examinations would no doubt aid materially also in securing better water for use in connection with dairy farms and in removing in advance a common source of suspicion in cases where contagious disease is found to exist.

A third class of private water supplies which may also have a marked effect upon the public health is the spring waters which are sold extensively for drinking in many of the cities and towns of the State. These waters have been examined by this Department from time to time in past years with the result that a number of objectionable sources were eliminated. It is now many years since funds have been available for making these examinations. Their importance appears to justify a sufficient appropriation for the thorough examination of these sources and the elimination of those which may be injurious to health.

RAINFALL AND STREAM FLOW IN 1915.

The total rainfall throughout the greater part of Massachusetts in the year 1915 has differed but little from the average of the past forty years, having been on the whole slightly less than the normal, as shown by some of the longer rainfall records available in the State.

While, however, the average rainfall has differed but little from the normal, its distribution has been most exceptional. In the month of January the total precipitation throughout the State, excepting in the extreme northwesterly and northeasterly sections, was generally about twice as great as the monthly normal. In February the precipitation was about the normal for that month throughout the State. The month of March was absolutely without precipitation throughout the

State, with the exception of a small area in the mountains west of the Connecticut River. The longest records of rainfall available fail to show the occurrence in any previous year of a rainless month of March at any station within the limits of Massachusetts. In the months of April, May and June the rainfall was extremely deficient in all parts of the State, though the amount of water in storage was generally somewhat greater than at the same time in the very dry year of 1911. On the early morning of July 1 occurred the most excessive fall of rain in a limited time that has been recorded anywhere in Massachusetts for many years. The total precipitation at Boston in the period from 1.30 to about 8.00 A.M. on that date amounted to 4.3 inches, the greater part of which fell in the period from 1.30 to 4.30 A.M. The precipitation continued excessive through July and August throughout the greater portion of the State, except in the southeast. In the months of September, October and November the rainfall was again deficient, and in December it exceeded the average.

The effect of this distribution of the rainfall on the water supplies of the State has naturally been very different from that which ordinarily obtains. The heavy precipitation in July and August raised the level of the ponds and reservoirs and increased the storage of the ground water supplies so that no case has come to the attention of the Department in which a shortage of water was experienced at any time during the year. The rainfall for the month of July was greater than in any year since 1897, and the flow of streams in that month probably greater than in any year since 1889. The conditions in the month of August were much the same as in July and the flow of streams excessive for that time of year. The quantity of water in storage at this date (Jan. 10, 1916) is greater than for many years, and, with an average rainfall in the coming winter and spring, it is reasonable to expect that all storage will be completely filled before the beginning of summer in 1916.

SANITARY PROTECTION OF PUBLIC WATER SUPPLIES.

Under the authority of section 113, chapter 75 of the Revised Laws, the Department has from time to time made rules and regulations for the sanitary protection of sources of water supply. The water supplies so protected are included in the following list: —

Abington and Rockland.
Amherst.
Andover.
Attleboro.

Braintree.
Brockton and Whitman.
Cambridge.
Chester.

Chicopee.
Concord.
Danvers and Middleton.
Easthampton.
Fall River.
Falmouth.
Fitchburg.
Gardner.
Great Barrington (Housatonic).
Greenfield.
Haverhill.
Hingham and Hull.
Holden.
Holyoke.
Hudson.
Leicester (Cherry Valley and Rochdale).
Lincoln and Concord.
Lynn.
Marlborough.
Maynard.
Montague.
Northampton.

North Andover.
Northborough.
Norwood.
Peabody.
Pittsfield.
Plymouth.
Randolph and Holbrook.
Rockport.
Russell.
Rutland.
Salem and Beverly.
Springfield.
Springfield and Ludlow.
Stockbridge.
Taunton.
Wakefield.
Westfield.
West Springfield.
Weymouth.
Williamsburg.
Winchester.
Worcester.

Rules and regulations made under the law cited above are enforceable by local authorities and are so enforced in the various cities and towns. The rules generally prohibit the cutting of ice on ponds used directly as sources of public water supply, but it has been the custom of local authorities to grant permits for ice cutting in cases where such use had been a practice before the water supply was introduced. The examinations of ponds and reservoirs while ice cutting was in progress have shown that the process results in the pollution of the water and is likely to cause sickness among those who use the water for drinking. It has been found impracticable to protect from pollution the water of ponds and reservoirs upon which ice cutting is carried on, even by the most careful inspection, and the practice should be discontinued on all ponds and reservoirs from which water is supplied directly for drinking.

SUPERVISION OF WATER COMPANIES.

Under the provisions of chapter 787 of the Acts of the year 1914, entitled "An Act to provide for the Supervision of Water Companies by the Board of Gas and Electric Light Commissioners," the duties

of the State Department of Health in relation to this subject ceased on July 7, 1914, except as to questions pending when that act became effective. Those matters were finally acted upon before the end of the year 1914. In 1915 an act was passed, chapter 21 of the General Acts of the year 1915, under which the State Department of Health may be required to furnish to the Board of Gas and Electric Light Commissioners engineering services and advice for its assistance and guidance in proceedings relating to the petition of any water company for authorization to issue capital stock or bonds, and in all matters connected with the determination by that Board of any question relating thereto and before any authorization is given by the Board of Gas and Electric Light Commissioners to issue capital stock or bonds. Only a very little work, and that of an informal character, has been required of the Department by the Gas and Electric Light Commissioners during the past year, but as matters of importance relating to those questions may come up at any time, it is recommended that an appropriation be made available to the Department for engineering expenses under that act. It is impracticable to estimate the amount of money likely to be required for carrying out the requirements of that act, but, under the circumstances, an appropriation of \$1,000 would appear to be a reasonable sum to provide in 1916 for the use of this Department in cases where engineering advice and assistance are requested by the Gas and Electric Light Commissioners.

EXAMINATION OF SEWER OUTLETS.

All main sewer outlets discharging into the sea or into tidal waters have been examined during the year, and special attention has been given to the distances to which sewage could be traced from such outlets and its effect upon the waters into which it is discharged and upon adjacent shores. At the outlet of the main drainage system of the city of Boston at Moon Island, where the sewage is stored in reservoirs and discharged in the first two hours of the outgoing tide, the conditions now prevailing differ but little from those of former years. The quantity of sewage discharged at this outlet in 1915 averaged about 100,000,000 gallons per day. In the course of the passage of this sewage from the city to the Moon Island outlet, it passes through settling tanks, or deposit sewers, so called, at the pumping station at Calf Pasture, thence through the tunnel and main outfall sewer to the reservoirs, where it is stored before discharge. In consequence of these conditions, the sewage becomes considerably decomposed, and putrefactive processes set in before it reaches the

place of disposal. The sewage is discharged through an outlet located at the surface of the water and covers a large area by the time the reservoirs are emptied. The odor in the neighborhood of the outlet and over much of the area in which the sewage is visible is offensive for a considerable time after the discharge, though the sewage very soon becomes thoroughly mingled with the harbor waters and its presence ceases to be noticeable.

At the outlet of the north metropolitan sewerage district at Deer Island the average quantity of sewage discharged during the year 1915 amounted to 60,000,000 gallons per day. The conditions about this outlet have remained much the same as in former years. The sewage is discharged continuously throughout the twenty-four hours and is rarely noticeable upon the surface of the sea beyond a distance of half a mile from the outlet. Greasy matters in the sewage, however, form a sleek, so called, upon the surface of the water, which is traceable often for considerably greater distances, though having no other noticeable effect upon the condition of the harbor waters. This outlet is located at the level of low water close to Deer Island Light and is objectionable to the keepers of the light. A new outlet is now being constructed through which the sewage will be discharged a short distance beyond its present location in about 50 feet of water at low tide.

The sewage of the south metropolitan sewerage district is discharged at two outlets about 1 mile north of Nut Island at the bottom of one of the main channels of the harbor, where the water is approximately 30 feet in depth at low tide. The outlets are used alternately, except at times when there is an excessive flow of sewage due to rain, when both outlets are used. During the past year a third outlet has been constructed at a point 1,400 feet north of Nut Island to provide relief at times of high flow in the main sewer. The average daily quantity of sewage discharged at the Nut Island outlets during the year 1915 was 51,000,000 gallons per day. The sewage discharged at these outlets is greatly diluted before reaching the surface of the sea and is noticeable over only a small area in the immediate neighborhood of the points of discharge, though sleek is noticeable at times at greater distances.

The outlet of the main sewerage system of the city of New Bedford has been in use continuously during the past year, and the quantity of sewage discharged there has amounted probably to about 50 per cent. of the total quantity discharged from the city sewers. The main intercepting sewer is being extended rapidly, and within a short time nearly all of the dry-weather flow of sewage from the city

will be discharged through the new outlet. This outlet is located in Buzzards Bay about two-thirds of a mile southeast of Clark's Point, where the water is 30 feet in depth at low tide. When examined during the past year, the sewage was noticeable in the surrounding sea water only for a maximum distance of about 200 feet, and evidence of its presence could not be detected by chemical or bacterial analysis beyond a limit of about one-fourth of a mile from the outlet. In fact, notwithstanding the large quantity of sewage discharged here, the outlet is very difficult to find.

No changes have been made in the system of sewage disposal at Fall River during the past year. Plans for the improvement of the Quequechan River, involving the construction of a main sewer to discharge the sewage and storm water from the Quequechan valley into Mt. Hope Bay, were approved by the Department in the latter part of the year, but the construction of these works has not yet been undertaken.

Early in the year plans for the collection and disposal of the sewage of the town of Danvers, including an outlet into Salem Harbor, were considered by the Department, and, in view of the advantage to Danvers of a sea outlet for its sewage and the great desirability of a change in the location of the present sewer outlet of the city of Beverly, the Department recommended that the question of a common outlet be considered by these municipalities. No definite action in the matter has yet been taken by the city and town concerned.

The sewer outlet at Salem discharges near the surface of the sea at low tide, and, in consequence, the sewage spreads at times over a wide area. While there is no evidence that it affects any of the neighboring shores, the outlet could be greatly improved if extended to deep water a short distance beyond its present location. The force main through which the sewage is conveyed from the Salem pumping station to this outlet was constructed for the use of the city of Salem only but is now used for the disposal of the sewage of both Salem and Peabody. While adequate for the purpose at present, a larger main will be needed at no distant time, and when such a main is constructed a new outlet in deep water should be provided.

The investigations relative to the disposal of the sewage of the city of Lynn, and the removal of the great nuisance that now exists along the shores of the harbor in the neighborhood of the present sewer outlet, have been carried on during the year under the direction of the joint board consisting of the State Department of Health and the municipal council of the city of Lynn. The results of these investigations will be presented in a separate report.

At the other main sewer outlets discharging into the sea or tidal waters there has been no change worthy of note during the past year.

Plans for a proposed temporary outlet into the sea for the sewage of the town of Hull were approved by this Department in 1914, the proposed outlet to be located in Hingham Bay on the westerly side of the town. The town has prepared plans for disposing of the sewage of the central portions of the town, including Nantasket Beach, by constructing a sewer from the neighborhood of the highlands at the southerly end of Nantasket Beach to an outlet into the sea off Allerton; and the temporary outlet was designed to give relief to certain areas in the town which are badly in need of sewerage until such time as the main sewer leading to the permanent outlet has been completed. The proper protection of the public health requires the removal of the sewage from about the dwelling houses in these areas at the earliest practicable time.

SEWAGE-DISPOSAL SYSTEMS.

The sewage-disposal system of the city of Fitchburg, which was completed late in 1914, has been operated regularly during the greater part of the year. The operation of the works was interrupted for a considerable time late in the year to make certain changes and repairs. The treatment works consist of five preliminary settling tanks with separate compartments for the digestion of sludge, 2.14 acres of trickling filters 10 feet deep, containing crushed stone 1 to 3 inches in size, and four secondary settling tanks for the sedimentation of the effluent after it passes the filters. While the works were in operation the analyses showed that they removed about 87 per cent. of the suspended solids contained in the sewage and somewhat less than 70 per cent. of the organic matter, as shown by the albuminoid ammonia.

The revolving screen and new trickling filter at Brockton have been in constant operation during the year, and analyses show that on an average 76 per cent. of the suspended solids and about 60 per cent. of the organic matter have been removed from the sewage. The sand filters at these works, which have an aggregate area of 30 acres, have not been maintained at the standard of former years. The capacity of these works is inadequate for the efficient purification of all of the sewage now being delivered at the works.

New works for the disposal of sewage from the town of Franklin were completed during the year. The works consist of a main sewer in the valley of Mine Brook which collects the sewage from all of the thickly settled parts of the town, with the exception of a small dis-

trict in the extreme easterly part of the main village, and conveys it to settling tanks and filter beds located in the valley of Mine Brook a short distance west of the village of Unionville. The disposal works consist of settling and dosing tanks for the sedimentation of the sewage and eleven sand filter beds having an aggregate area of about 3.24 acres. The effluent of these filters is discharged into Mine Brook.

At Framingham considerable improvement has been made in the operation of the filters by the removal of clogged sand from some of the beds and by the construction of additional underdrains.

At Pittsfield additional filters have been constructed during the year, increasing the area available for the disposal of the sewage by about 50 per cent.

At Hopedale the filtration works have been improved and the area enlarged by the construction of additional beds, making an aggregate filtration area of about 3.79 acres.

The new filters at Attleboro have operated satisfactorily during the year, and the same may be said of nearly all of the other principal sewage-disposal works in the State. In some cases, however, as at Southbridge, less care has been exercised than necessary to secure the best results, and in two or three cases, especially at Gardner and Natick, better methods of applying the sewage to the filters would improve the effectiveness of the works.

The following is a list of the principal sewage disposal works in operation in the State: —

Amherst.
Andover.
Attleboro.
Billerica.
Brockton.
Clinton.
Concord.
Easthampton.
Fitchburg.
Framingham.
Franklin.
Gardner.
Hopedale.
Hudson.
Leicester.
Lenox.
Longmeadow.

Marion.
Marlborough.
Maynard.
Medfield.
Milford.
Natick.
North Attleborough.
Northbridge.
North Brookfield.
Norwood.
Pittsfield.
Southbridge.
Spencer.
Stockbridge.
Westborough.
Worcester.

INSANITARY CONDITIONS DUE TO LACK OF SEWERAGE.

About one-half of the cities and towns in the State which have public water supplies are provided with systems of sewerage. While the introduction of a public water supply always increases materially the quantity of sewage requiring disposal in a city or town, it by no means follows that the introduction of a sewerage system becomes essential at once upon the introduction of a public water supply. The need of sewerage in a populous area varies with the geological conditions, and a number of towns of considerable size having public water supplies have been able to maintain satisfactory sanitary conditions without sewerage where the porosity of the soil and depth to ground water are adequate for the proper disposal of the sewage in vaults and cesspools. There are many towns, however, in which it is nearly impracticable to maintain proper sanitary conditions in the thickly settled portions at the present time owing to lack of sewerage, chief among these being the towns of Braintree, Bridgewater. Danvers, Mansfield, Marblehead, Reading, Rockland, Saugus, Stoughton, Weymouth and Whitman. At best it is usually necessary to clean out vaults and empty cesspools at more or less frequent intervals, a process in itself inevitably involving a very considerable nuisance. Moreover, in the disposal of such waste great care is necessary to prevent danger of the pollution of sources of water supply.

It often happens, however, that, owing to an impervious soil or the saturation of the ground by the increasing quantity of sewage discharged into cesspools in a growing community, the maintenance of proper sanitary conditions in the thickly built-up section of a town becomes practically impossible. In the spring and at times of heavy rain at other seasons of the year, sewage overflows from the cesspools to the nearest drain or water course, with the result that conditions are created which are likely to be injurious to health. In the towns mentioned above the conditions are very objectionable in the densely populated areas, and it is impracticable to attempt to obtain relief by the enforcement of health regulations unless an adequate means of sewage disposal is first provided.

In practically all of these towns action has already been taken by the town toward the introduction of a sewerage system by the preparation of plans and estimates of the probable cost of the necessary works, but as yet no further action has been taken toward the introduction of sewerage works. In some of these towns the method of disposal of the sewage presents a serious problem and requires co-operation with other municipalities or districts, as in the case of

Danvers, already mentioned, and also in the case of Reading. In the latter case, by direction of the Legislature of 1914, plans for the disposal of the sewage were made by this Department and the metropolitan water and sewerage board, acting jointly, and were presented in a report to the Legislature of 1915 (House Document No. 6). As a result of this investigation, it was found that it would be very difficult and expensive for the town to dispose of its sewage within its own limits and that the best method of disposal was the discharge of the sewage into the north metropolitan sewerage system through an extension of the Stoneham branch of that system.

POLLUTION OF RIVERS.

The pollution of rivers in 1915 has on the whole been somewhat less noticeable than in other recent years on account of the fact that the flow of streams in the months of July and August was greater than has occurred in those months in a period of a quarter of a century. With a deficient rainfall in the months of September, October and November, the flow of streams fell to less than the average, and the effect of the pollution of streams became in some cases more marked than in previous years.

In many of the river valleys the factories have recently begun to operate more fully than has been the case for a number of years, and if present conditions should continue stream pollution is likely to be more serious in the coming year than has hitherto been the case, unless the rainfall and stream flow are much greater than usual.

The most seriously polluted rivers in Massachusetts at the present time are the Blackstone, the Neponset, and the north branch of the Nashua below Fitchburg and Leominster, and the condition of these streams in the latter part of the summer and through the autumn was very objectionable. The Hoosick, the Assabet, the French and the Taunton rivers are also in places very badly polluted.

Assabet River.

The condition of the Assabet River shows no material change from former years. In the upper portion of its course below Westborough and Hudson this river was formerly very seriously polluted, but in later years the condition of its upper waters has not been objectionable. The examinations of the past year show a slight increase in pollution above Maynard. At Maynard the river receives a very large quantity of manufacturing wastes, including a considerable quantity of sewage from the town, and, while partial works have al-

ready been installed for the treatment of the manufacturing wastes at Maynard, the pollution of the river shows no material change in the past three years. The river is a very badly polluted one, and more efficient treatment of the manufacturing wastes and sewage at Maynard is necessary before the river can be maintained in a satisfactory condition. Plans for a sewerage system are under consideration by the town of Maynard, and experiments are now being made upon the treatment of the manufacturing wastes discharged from the mills, the efficient purification of which involves many difficulties and a considerable expense.

Blackstone River.

The pollution of the Blackstone River was carefully investigated in 1913 by direction of the Legislature, and a description of the sources of pollution of that stream was presented in the report of the State Board of Health for 1913 (House Document, No. 2163, session of 1914).

During the past year a new sewer has been completed by the city of Worcester which carries a much larger quantity of sewage to the disposal works, thus relieving appreciably the pollution of the stream above the disposal works as compared with the previous year. Farther downstream at Millbury, Uxbridge and Blackstone the river shows evidence of more serious pollution than in any former year since examinations of the river were begun by this Department nearly thirty years ago.

Charles River.

The Charles River, which has hitherto received comparatively little contamination, has shown evidence of a greater degree of pollution in the past year than has ever thus far been recorded. These conditions are doubtless due, in part, to the overflow of sewage from inadequate sewage-disposal works at the Medfield State Hospital, plans for the enlargement of which are now under consideration. This river is used to a very great extent as a source of public water supply, the water being drawn from wells and filter galleries adjacent to the river, especially at Dedham, Brookline, Newton and Waltham.

In view of the conditions, it is of the utmost importance that the river be kept free from sewage pollution.

The recent installation of a sewerage system and purification works at Franklin, which were designed of sufficient size to receive also such manufacturing wastes as might reasonably be admitted thereto, should assist materially in maintaining the purity of the Charles River, provided the manufacturing wastes discharged from the fac-

ories in that town are also properly cared for. Further improvement will no doubt be made in the condition of the river when the sewerage system for the town of Wellesley, now under construction, has been completed.

Chicopee River.

The Chicopee River in the lower part of its course has been less polluted recently than in former years. Farther upstream, below Spencer and below Palmer, there have been somewhat greater evidences of pollution during the past year than has formerly been the case. Among the tributaries of the stream, Chicopee Brook, flowing through Monson, has shown a greater degree of pollution in the past year than ever before, and the same is true of the Ware River for a considerable distance above its junction with the Chicopee River. The pollution of Chicopee Brook is caused by sewage and manufacturing waste from the town of Monson, and the conditions have now become such that sewage-disposal works are necessary to prevent the gross pollution of this stream. A sewage-disposal system has also become necessary in the town of Ware to prevent the offensive pollution of that stream in the lower portion of its course.

The condition of the other tributaries of the Chicopee River has remained about the same as in former years.

Concord River.

The Concord River is formed by the junction of the Assabet and Sudbury rivers at Concord. The Assabet River, as already indicated, is very seriously polluted, chiefly by manufacturing wastes and sewage in the town of Maynard, and the pollution is noticeable down to the point where this stream joins the Sudbury River. On the Sudbury River the chief pollution is that which is caused by the discharge of manufacturing wastes from the woolen mills at Saxonville. There has been little change in the conditions affecting the pollution of the Sudbury River as compared with former years, though somewhat more organic matter has been present in its waters than was formerly the case.

The Concord River receives very little pollution throughout the greater portion of its course. At North Billerica, about 4 miles above its mouth, the river receives a small amount of pollution from the mills at that place, though its condition is not objectionable until it enters the city of Lowell. Within the limits of Lowell the Concord River is badly polluted by sewage and manufacturing wastes down to the point where it joins the Merrimack River.

Connecticut River.

The condition of the Connecticut River has been rather better throughout its course in Massachusetts than has been the case for several years, this condition being due no doubt to the fact that the flow of the stream in the warmer portion of the year was much greater in 1915 than for many years. The river in general is not seriously polluted, but objectionable conditions are found in the vicinity of certain sewer outlets in the various cities and towns along its bank, chiefly in Holyoke and Springfield. In many cases nuisances about sewer outlets along the river have been relieved by extending the sewers to a point of discharge in the bed of the stream at a sufficient distance from the river bank to prevent the sewage from returning thereto until it has mingled thoroughly with the river water.

Of the smaller tributaries of the Connecticut River, the Mill River at Northampton shows considerable improvement above the main sewer outlet as compared with last year. The better condition of the stream this year is probably due largely, however, to the excessive flow of water during the summer season as compared with ordinary conditions.

The Manhan River also shows improvement as compared with former years, a condition doubtless due to the same cause.

The main sewer of the town of Amherst, designed to convey the sewage of the greater portion of that town to the Connecticut River, has been under construction during the past year and is now nearly completed. With the completion of this sewer it will be practicable to relieve greatly the serious pollution of the Fort River, one of the smaller tributaries of the Connecticut.

French River.

The French River has become one of the most seriously polluted rivers in the State. The pollution of its upper waters is caused chiefly by manufacturing waste, and the amount of such pollution is great enough to produce objectionable conditions in the river at several points along its course above the town of Webster. At Webster the river receives the manufacturing wastes from a large woolen mill and from cotton mills and print works in addition to the sewage of the town, and the condition of the stream below Webster during much of the past summer has been very objectionable. The outlets from which sewage and manufacturing wastes are discharged into the river at Webster are located within about 1.5 miles of the boundary line of the State of Connecticut, and the effect of the gross pollution of the

stream at Webster is very marked at the point where the river passes out of Massachusetts. The circumstances require that the sewage and also the more objectionable of the manufacturing wastes discharged into the river shall be purified if the stream is to be maintained in proper sanitary condition.

Hoosick River.

The condition of the Hoosick River below North Adams has been better during the past year than in any recent summer season, an improvement which is due no doubt to the great dilution caused by the heavy rainfall of July and August. The north branch has shown somewhat greater evidences of pollution than in previous years, though its condition is not objectionable. The waters of the south branch below Adams have been less polluted than usual, a condition which is due undoubtedly to greater dilution.

Housatonic River.

An examination of the Housatonic River shows improvement in the condition of the river in 1915 as compared with previous years. More care has been taken recently to prevent the entrance of sewage into the stream at Pittsfield, and during the past year practically all of the sewage has been pumped to the disposal works. These works have been enlarged about 50 per cent. during the past year, an improvement which will aid materially in preventing the discharge of unpurified or partially purified sewage into the river, but with this enlargement the works are no more than sufficient to care for the present quantity of sewage. The condition of the river at points below Pittsfield has shown improvement as compared with former years, a condition which is doubtless due, in part at least, to the great dilution caused by the heavy rainfall during the summer.

Merrimack River.

The condition of the Merrimack River from the point where it enters the State down to the city of Lowell has been about the same as in former years. Between Lowell and Lawrence its condition has been somewhat better than in former years, an improvement doubtless due to greater dilution. It is probable that more wool-scouring waste was discharged into the river at Lawrence than for several years, and below Lawrence the river has contained more organic matter than ever before, but farther down, near the mouth of the river, its condition has been about the same as in previous years.

The following recommendation contained in the report of this Department in 1913 has not yet been carried out:—

. . . It appears to the Board advisable that a limit be placed upon the time in which these objectionable wastes shall be allowed to discharge into the stream, and that a limit of time should also be specified within which the work of improving satisfactorily the condition of the sewer outlets in the cities and towns along the river shall be completed.

Nashua River.

The main intercepting sewer designed to intercept the dry-weather flow from the sewers of the city of Fitchburg, which formerly discharged into the stream at numerous points along its course through the city, has now been completed nearly to its extreme westerly limits, and during 1915 most of the dry-weather flow of sewage has been conveyed to the disposal works, situated near the extreme southeasterly boundary of the city. The sewage has been treated in the settling tanks and trickling filters at the disposal works during much of the year, though the operation of the works was discontinued for a time in order to make necessary repairs. The condition of the north branch of the Nashua River below the city, but above the disposal works, has been less objectionable than in former years. Below the disposal works the river has shown improvement, though its condition when the disposal works were not in operation was worse than in any former year. A similar condition was found to exist throughout the greater portion of the length of the river to the point where it joins the south branch at Lancaster.

The town of Leominster began during the past year the necessary preliminary investigations for the construction of a system of sewage disposal, and plans for disposal works are in preparation.

Neponset River.

The Neponset River has shown no material change during the past year as compared with the previous year, though its condition in the past three years has been somewhat better than formerly. A general description of the conditions along this stream and references to the works constructed for the prevention of its pollution will be contained in a report relative to the improvement of the Neponset River to be presented to the Legislature by this Department.

Taunton River.

The Salisbury Plain River, a tributary of the Taunton River, continues to show improvement below the city of Brockton as compared with previous years. The Town River, another tributary of the Taunton, has shown, on the other hand, a marked increase in pollution below Bridgewater, and the condition of this stream is rapidly becoming objectionable, a condition which is due, in part, to the effluent discharged from the Brockton filter beds, to which reference has already been made. The Coweaset River, one of the tributaries of the Town River which receives effluent from the Brockton filter beds, has been very seriously polluted during the past year. The Nemasket River, another tributary of the Taunton, is polluted badly by the sewage of Middleborough, and the Three Mile River, a tributary of the Taunton which enters the main river below the city of Taunton, is badly polluted, chiefly by wool scouring and other manufacturing wastes in the town of Norton and the city of Taunton. The Taunton River itself below the point where it receives the sewage of the city of Taunton has shown a decided increase in pollution during the past summer as compared with any previous year. The limit of time within which the city of Taunton was to have constructed works for the purification of its sewage has expired, but the works have not yet been constructed.

Other Rivers.

Of the remaining principal river basins in the State, the most important are the Millers, the Deerfield and the Westfield. The Millers River is polluted by sewage at Winchendon, Athol, Orange and Millers Falls, and this pollution has been greater, judging by the chemical analyses of the water, than in any previous year. The sewage effluent from Gardner, which has not been well purified, has also had an unfavorable effect upon the stream during the past year. In general, the appearance of the river and its tributaries is not objectionable, except in the immediate neighborhood of sewer outlets.

The Deerfield River is practically an unpolluted stream throughout the greater part of its course. Just above its mouth, however, it is polluted considerably by the sewage of the town of Greenfield which is discharged into the stream after passing through settling tanks. While the conditions below this sewer outlet have not been seriously objectionable during the past year, there is no doubt that, in order to maintain the river in proper sanitary condition, further treatment of the sewage of Greenfield will be required at no distant time.

The Westfield River, like the Deerfield, receives comparatively little

pollution throughout the greater part of its course. Its chief pollution is that caused by the sewage of the town of Westfield which is discharged into the stream without treatment at points below the town. The conditions produced by the disposal of sewage at this point have not been objectionable during the past year.

The Quinebaug River above Southbridge receives very little pollution. At Southbridge considerable quantities of manufacturing wastes are discharged into the river, and the stream is also polluted considerably by sewage and a poorly purified effluent from the sewage-disposal works of the town. With proper care, the disposal works are capable of treating all of the sewage effectively and preventing the further serious pollution of the river. Its condition has not, however, been seriously objectionable during the past year.

NORTH RIVER IN SALEM AND PEABODY.

The condition of the North River in Salem and Peabody has shown no very material improvement during the past year. The sewerage system of Salem and Peabody has not yet been completed by the construction of a pump well of suitable design to avoid the necessity of backing up the sewage in the main sewer in order to operate the pumps. Considerable work has been done by manufacturers in the town of Peabody in the installation of tanks for the removal of solid matter from their wastes, which aids in the creation of deposits in the main trunk sewer. It is unlikely, however, that a very material improvement in the condition of the North River can be effected until a suitable pump well has been provided and the backing up of the sewage in the trunk sewer prevented. More care must also be taken in maintaining the settling tanks at the various factories.

IMPROVEMENT OF THE NEPONSET RIVER.

The work of improving the channel of the Neponset River, under chapter 655 of the Acts of 1911 and acts in addition thereto, was completed early in the year, so far as provided for in those acts. The results of investigations upon the further improvement of this river, together with a description of the work already done, will be presented in a separate report.

DRAINAGE OF WET LANDS.

The unexpended balance of \$24,547.55 of the appropriations aggregating \$25,000, which the departments of agriculture and health were directed to expend in the drainage of wet lands, under the provisions

of chapter 759 of the Acts of 1913 and chapter 596 of the Acts of 1914, was early in January, 1915, transferred to the State Forester, to be used for the employment of the unemployed.

The subject of the improvement of wet lands is a very important one and will doubtless be taken up again at no distant time. In the meantime it is advisable that definite information be collected relative to the extent and character of the larger areas of swamp lands in the State, and that such preliminary studies be made of the areas most suitable and available for drainage as will show with reasonable accuracy the probable cost of the drainage of such areas and their probable value after improvement. A great amount of such work is now being carried on in several States, especially in the west and south, where agricultural lands are at least no more valuable after improvement than many of the accessible areas of swamp and marsh lands in Massachusetts. Such an investigation would involve no great expense and its results would be of great value in ascertaining the advantages and probable cost of improving such areas.

In conclusion, attention is called to the need of additional funds for carrying out the laws relative to the protection of inland waters if the increase in the pollution of streams lately noticeable is to be checked and their excessive pollution prevented. For the effective protection of the waters of the State, purification works must be established in increasing numbers, and if the State is to continue to give such aid as it can with expert advice to cities, towns and manufacturers in the construction, maintenance and effective operation of works for the protection of water and the disposal of sewage and other objectionable wastes, it will be essential that additional funds be provided for the work. The requisitions upon the Department for advice and assistance in matters relating to water, sewerage and the disposal of wastes have increased rapidly in the last few years, and, with the renewed industrial activity recently noticeable, these demands cannot longer be met effectively within the limits of the amount now provided for this work.

ADVICE TO CITIES, TOWNS AND PERSONS.

Under the provisions of the Revised Laws (chapter 75, section 117), the State Board of Health is required to

consult with and advise the authorities of cities and towns and persons having, or about to have, systems of water supply, drainage or sewerage, as to the most appropriate source of water supply, and the best method of assuring its purity or as to the best method of disposing of their drainage or sewage with reference to the existing and future needs of other cities, towns or persons which may be affected thereby. It shall also consult with and advise persons engaged or intending to engage in any manufacturing or other business whose drainage or sewage may tend to pollute any inland water as to the best method of preventing such pollution, and it may conduct experiments to determine the best methods of the purification or disposal of drainage or sewage. No person shall be required to bear the expense of such consultation, advice or experiments. Cities, towns and persons shall submit to said board for its advice their proposed system of water supply or of the disposal of drainage or sewage, and all petitions to the general court for authority to introduce a system of water supply, drainage or sewerage shall be accompanied by a copy of the recommendation and advice of said board thereon.

During the year 1915 advice has been given to the following cities, towns and persons who have applied for such advice under the provisions of this act or under special acts relating to water supply and sewerage.

Official communications were made during the year under the provisions of acts relating to water supply and to sources of ice supply, as follows: —

WATER SUPPLY.

Arlington.	Canton (Massachusetts Hospital School).
Arlington (well).	
Attleboro (well of J. E. Blake Company).	Canton (American Fireworks Company).
Attleboro (well in Hebronville).	Chelmsford (wells) (two).
Belchertown.	Chelsea (well of Rossi Bros. Company).
Bernardston.	Chicopee (Willimansett).
Billerica (wells of Boston & Maine Railroad car shops).	Dalton.
Bridgewater (well).	Dana (springs at Dana Center School).

Deerfield (Boston & Maine Railroad,
East Deerfield) (two).
Dracut (well at Kenwood School).
Duxbury.
Eastham (well).
East Longmeadow (well).
Easton (North Easton Village Dis-
trict).
Easton (South Easton and Eastondale
Fire and Water District).
Easton (Unionville).
Enfield (spring).
Essex (Town Farm).
Fairhaven (well at Fort Phoenix).
Fall River (four).
Falmouth.
Fitchburg (two).
Framingham.
Framingham (well in Saxonville).
Franklin (wells).
Gardner (well).
Georgetown.
Georgetown (wells) (two).
Greenfield.
Hanover.
Hanover (wells) (two).
Harwich (wells in Harwich Center).
Holyoke (Valley Paper Company).
Hubbardston (well).
Ipswich.
Ipswich (well at Rose Tree Inn) (two).
Lawrence (well at Everett Mills).
Lawrence (well at Wood Worsted
Mills).
Lawrence (well at Washington Mills).
Lenox.
Lenox (spring in Lenox Dale).
Lowell (two).
Lowell (United States Cartridge Com-
pany) (two).
Lowell (spring).
Lunenburg.
Lynn (H. P. Hood & Sons).
Mansfield.
Marblehead.
Marion.

Marshfield (Webster Terrace Land
Company).
Medfield (well).
Medford (Fulton Spring).
Milton (well).
Monson (State Hospital) (two).
Montague (Turners Falls) (two).
New Bedford.
North Adams (two).
North Attleborough (Webster Com-
pany) (two).
Northbridge (Rockdale).
Northfield (Northfield Schools).
Norwell (well at school).
Orange (well at school).
Oxford (Town Farm).
Palmer (wells and springs).
Peabody (four).
Peabody (Crystal Spring).
Provincetown (wells).
Reading (well).
Rowley (wells) (four).
Salem (two).
Salem (springs).
Salisbury.
Sandwich (water supply of Massachu-
setts Volunteer Militia).
Somerset (well).
Southborough (well).
Southborough (well at Winchester
Place) (two).
Southbridge (well).
South Hadley (South Hadley Falls).
South Hadley (Hadley Mills).
Sterling (spring).
Stoughton (well).
Sutton (wells).
Swansea (Swansea Dye Works).
Templeton (well in Baldwinsville).
Tewksbury (wells at schools).
Townsend (Townsend Center).
Tyngsborough (spring).
Warren.
Watertown (well).
Wayland.
Webster (well).

Wellesley.	Weston (Riverside Recreation Grounds).
Wellesley (spring in Metropolitan Park Reservation).	Weston (well at boys' camp).
Westfield.	Westport (wells) (two).
West Newbury (well).	Wilmington (well at High School).
Weston (Hubbard estate).	Winchendon (wells).
Weston (Blake estate).	

ICE SUPPLY.

Colrain.	Palmer.
Duxbury.	Pepperell.
Falmouth.	Pittsfield (Berkshire Street Railway Company).
Franklin.	Salisbury.
Greenfield.	Southbridge.
Harvard.	Springfield.
Mansfield.	
Newton.	

Official communications were made during the year under general and special acts relating to sewerage and sewage disposal, as follows: —

Amherst.	Leicester.
Andover (three).	Marion.
Beverly.	Marlborough.
Bridgewater.	Maynard.
Brockton (Brockton Gas Light Company).	Methuen (Barker School).
Canton (Springdale Finishing Company).	Nahant.
Danvers.	Northfield (Northfield Hotel Company).
Danvers (Danvers Leather Company) (two).	Norwood (Winslow Bros. & Smith Company) (two).
Deerfield (South Deerfield).	Peabody (T. H. O'Shea Leather Company).
Dracut (American Woolen Company).	Peabody (J. F. Ingraham Company).
Edgartown (North School).	Peabody (Thayer-Foss Company).
Fall River.	Pittsfield.
Foxborough.	Salisbury (Salisbury Beach).
Framingham (two).	Stoneham.
Gardner (proposed isolation hospital) (two).	Wakefield.
Gardner (Gardner State Colony).	Wellesley.
Haverhill (five).	Westborough.
Hopedale (Draper Company).	Westfield.
Huntington.	West Springfield.
Lakeville (Lakeville State Sanatorium).	Wrentham (State School).

MISCELLANEOUS.

Attleboro (Y. M. C. A.) (two).	Pittsfield (Coolidge Memorial Hospital).
Belchertown (proposed school for feeble-minded).	Plymouth.
Beverly.	Quincy.
Braintree.	Sherborn (Jacob Lander).
Conway (proposed school for feeble-minded).	Southborough.
Danvers (two).	Southwick (proposed school for feeble-minded).
Fairhaven.	Watertown.
Gardner (contagious disease hospital).	Winchester.
Lynn.	Winthrop.
New Bedford.	Woburn.
Norwood (Norwood Civic Association).	Woburn (F. C. Parker & Son Company).
Peabody.	Woburn (Woburn Gas Light Company).

WATER SUPPLY.

The following is the substance of the official action taken during the year in reply to applications for advice relative to water supply: —

ARLINGTON.

MAY 15, 1915.

To the Board of Health, Arlington, Mass.

GENTLEMEN: — In response to your request of May 1, 1915, for an examination of the water of the Arlington Reservoir and advice as to its condition, the Commissioner of Health has caused the reservoir and its surroundings to be examined by the engineer of the Department and samples of the water to be analyzed.

The results of the analyses show that there has been a marked increase in the quantity of chlorine and nitrates as compared with its condition ten years ago and that the hardness has materially increased. The quantity of organic matter present in the water is about the same as was the case ten years ago, while the color at the present time is considerably less.

The microscopical examination shows a considerable increase in the number of vegetable organisms present in this water as compared with its condition ten years ago.

There has been a marked increase in the population on this watershed in recent years and there are also extensive areas of cultivated land within this watershed. While there is no evidence that the water

receives direct pollution, it evidently receives much filtered sewage, and much larger quantities of nitrates doubtless enter the reservoir than was the case in earlier years. These conditions are favorable to the presence and growth of microscopic organisms. The bottom of the reservoir was never prepared for the storage of water and this condition, together with the quantities of nitrates that evidently find their way into the reservoir, is very favorable for maintaining growths of microscopic organisms, of which the water contains large numbers at the present time. These organisms are found in practically all ponds and reservoirs, the numbers varying with the food supply present in the bottom of the reservoir or in the water which enters it from the watershed. Reservoirs which have been thoroughly prepared for the storage of water by the removal of all soil and organic matter from the area flowed and which receive their waters from uninhabited or sparsely settled watersheds affected but little by pollution from dwelling houses and cultivated lands contain few organisms, the number rarely being sufficient to affect the appearance, taste or odor of the water even upon close inspection. On the other hand, in reservoirs, such as that at Arlington, containing considerable food supply in the reservoir itself and a very large supply in the waters which feed it, organisms are usually present in large numbers, even in such abundance as to give the water an objectionable appearance and an offensive taste and odor. These conditions are not known to be injurious to health, even if the water is used for drinking, and it is not probable that the water of the Arlington Reservoir will cause objectionable conditions in the neighborhood or injury to the health of those who may resort to the reservoir for bathing or who may use the waters drawn therefrom for that purpose.

Attempts made to restrict the growths of organisms in this reservoir by the use of chemicals, such as copper sulphate, were made several years ago, but the character of the organisms growing in this water is such that this treatment was found to have comparatively little effect in reducing organic growths.

The water could of course be made more satisfactory by filtration, though the expense would be likely to be considerable. There appears to be no reason, however, for fearing any danger to health from the conditions about this reservoir or the use of its water for bathing at the present time.

BELCHERTOWN.

JUNE 4, 1915.

To the Committee on Water Supply, Belchertown, Mass., Mr. F. M. FULLER, Chairman.

GENTLEMEN: — The State Department of Health received from you on May 14, 1915, an application for its approval, under the provisions of chapter 287 of the Special Acts of the year 1915, section 2, of the taking of water for the supply of Belchertown from Chambray Brook, supplemented with water from the system of tubular wells near Jabish Brook east of the village, the use of which was approved by this department as a source of water supply for Belchertown in a communication to the Belchertown Water Company under date of Oct. 22, 1913.

In response to this application, the Commissioner of Health has caused the sources of supply to be examined and samples of the water to be analyzed. It appears from the information presented that Chambray Brook, above the point at which the water would be taken for the supply of the village of Belchertown, has a drainage area by actual survey of 0.63 of a square mile and that the small intake reservoir which it is proposed to construct on this brook in the beginning will be located at an elevation of about 200 feet above the summit of the hill on which the main village of Belchertown is located. The investigations also show that it is practicable to build a storage reservoir having a capacity of 6 million gallons on this brook by the construction of a dam about 36 feet in height and that the amount of storage can be made greater in case of need by the construction of a higher dam. It is also practicable, instead of constructing a storage reservoir, to take water from the system of tubular wells already approved by this department as a source of water supply for Belchertown.

The results of an analysis of the water of Chambray Brook show that, while it has at times considerable color, it is very soft and in other respects of good quality for the purposes of a public water supply and, since the watershed contains only a very few buildings, it will be practicable to protect the purity of the supply without serious difficulty or expense.

The quantity of water which Chambray Brook will yield under present conditions would not be sufficient in a very dry year to supply all of the water that is likely to be required for Belchertown, but with a small intake reservoir having a capacity of about one million gallons as proposed, however, enough water is likely to be obtained in the beginning and until the water supply comes into general use. It will

be practicable without serious difficulty to supplement the supply readily from the system of tubular wells near Jabish Brook, and with this arrangement, using the wells whenever the flow of Chambray Brook is insufficient, there is no doubt that an adequate supply of good water for all the requirements of Belchertown can be provided at all times.

Having considered the circumstances, the State Department of Health hereby approves the taking of water from Chambray Brook, supplemented when necessary with water from the tubular wells near Jabish Brook, for the supply of the town of Belchertown under the provisions of chapter 287 of the Special Acts of the year 1915, and also approves the location of the intake dam and reservoir at Chambray Brook, as indicated on the plan presented, and the location of the wells approved by the department under date of Oct. 22, 1913.

It is important, in order to secure an adequate quantity of water for the town at all times, that the works shall be constructed in strict accordance with the plans of your engineer, and it is also important that a weir be placed at some suitable point in Chambray Brook above the proposed intake reservoir and the flow of the stream accurately measured to determine its yield and the quantity of storage that will be necessary or desirable to provide for the best practicable development of this stream. The present season has thus far proved an extremely favorable one for such an investigation, and it is recommended that the weir or measuring station be placed in operation at the earliest possible time and daily observations made thereon at least during the remainder of the present year.

BERNARDSTON.

AUG. 14, 1915.

To the Water Supply Committee, Bernardston, Mass., Mr. HUGH E. ADAMS, Chairman.

GENTLEMEN: — The State Department of Health received from you on June 14 an application for advice as to a proposed water supply for Bernardston accompanied by plans of suggested works and a report by your engineer relative thereto.

It appears from the information submitted that two schemes of water supply for the town have been considered, by one of which the water will be supplied by gravity from a reservoir to be constructed on Mill Brook about $1\frac{1}{2}$ miles west of the village, while by the other scheme the water will be taken from the ground at a point in the valley of Mill Brook about an equal distance southwest of the village. The first cost of the works would be about the same if either plan

were adopted, but the cost of maintenance would be much greater in the case of the ground water source, the water of which would have to be supplied by pumping.

The Commissioner of Health has caused the locality to be examined by the engineer of the Department, has considered the plans and information presented and has caused a sample of water from the proposed location of the reservoir on Mill Brook to be analyzed.

The results of the examination show that the water of Mill Brook is clear, colorless and odorless and naturally of very good quality for domestic use. There is some doubt as to the exact area of the watershed above the point at which it is proposed to construct the reservoir, but it is probable that the watershed is ample, with a reservoir having a capacity of about 2,500,000 gallons as proposed, to supply an adequate quantity of water for all the requirements of the village of Bernardston at the present time. The watershed is for the most part mountainous and contains very few dwelling houses, but these places are so situated that it is advisable that they be acquired by the town in case the water supply is taken from this stream in order to protect the supply from danger of contamination; and the cost of acquiring the dwelling houses within the watershed should be included in determining the probable cost of the works for taking water from this source.

An examination of the proposed location for a ground water supply does not disclose any very definite indications as to the practicability of obtaining an adequate supply of good water for the village in this locality. A test of the ground water by means of wells will be necessary before definite conclusions can be reached as to the practicability of obtaining a supply of good water for the village from this locality.

An examination of the valley of Falls River above the village shows that the indications are fully as favorable for obtaining a supply of water from the ground at a point on the easterly side of the river a short distance north of the village and also at a point on the westerly side of the river about $\frac{3}{4}$ of a mile north of the village as are found in the location at present under consideration.

It is probable that if an adequate supply of good water can be obtained in either of the more favorable localities in the valley of Falls River above the town, the cost of the works would be considerably less than the cost of works for taking water from Mill Brook, including the expense of protecting the purity of the latter source; and considering the circumstances, it is desirable that test wells be driven in the localities indicated north of the village to determine whether a sufficient supply of ground water of good quality for the

requirements of the village can be secured there. If the conditions are found to be favorable for obtaining an adequate ground water supply in that region, a careful estimate of the cost of the necessary works and of the cost of operation and maintenance should be prepared for comparison with the estimated cost of works for taking water from Mill Brook, including the cost of acquiring the lands necessary for the protection of the purity of that supply.

If you decide to make investigations for a ground water supply in the valley of Falls River, the Department will, if so requested, make the necessary analyses of water from test wells, and when these results and the estimates of the cost are available will give you further advice as to the most desirable source of supply for the town to adopt.

BILLERICA (BOSTON AND MAINE RAILROAD CAR SHOPS).

OCT. 21, 1915.

TO MR. EDWIN MULREADY, *Commissioner of Labor, State Board of Labor and Industries, Boston, Mass.*

DEAR SIR:— In response to your request for an examination of the water used in the car shops of the Boston & Maine Railroad in North Billerica and advice as to its use for drinking, the State Department of Health has caused the sources of supply used by that company at that point to be examined and samples of the water to be analyzed.

The results of the examination show that the water from which the supply for drinking is obtained is drawn from eight tubular wells which are located in the factory grounds just northwest of the power house, whence it is pumped through a separate system of pipes, in which it is cooled by ice, to the various fountains at which the water is supplied for drinking.

Analyses of water at various points on the tubular well system show that it is turbid and colored and that it contains a much greater quantity of organic matter than is found in good well waters, together with an excessive quantity of iron. There is no indication that the water is seriously polluted, and its objectionable condition is undoubtedly due almost wholly to the excess of iron which the water contains which makes it objectionable for drinking and other uses, chiefly in this case on account of the disagreeable taste and odor.

The wells are located in gravelly soil but there are large deposits of organic matter in the immediate neighborhood and, considering the large quantity of water drawn from the wells, it is probable that the disagreeable character of the water is due to water which has come

in contact with organic matter in the ground in their neighborhood. The water could doubtless be purified and rendered satisfactory for drinking by efficient filtration, but the expense of such an improvement and its maintenance would probably be greater than the cost of the introduction of a new supply from some suitable location in the neighborhood.

OCT. 21, 1915.

To the Boston & Maine Railroad, Boston, Mass.

GENTLEMEN: — In response to a request from the Commissioner of Labor, the State Department of Health has examined the wells from which water is obtained for drinking at your shops in Billerica and has advised the Commissioner that the water contains a greater quantity of organic matter than is found in good well waters and an excessive quantity of iron which make it objectionable for drinking and other uses. A copy of this communication is appended hereto.

A test well driven last year in the valley of a small brook one-third of a mile or more southwest of the wells from which your present supply for drinking is drawn was found to contain water of good quality. It is advisable, in the opinion of the Department, that a further test be made in this region by putting in additional wells, and if the results are favorable a pumping test should be made to determine the probable quantity and quality of the water obtainable from the ground in that region.

The Department will assist you in such further investigations, if you so request, by making the necessary analyses of water and will give you further advice relative to the water obtainable in this region if the results of the tests are submitted.

CANTON (MASSACHUSETTS HOSPITAL SCHOOL).

JAN. 18, 1915.

*To the Board of Trustees, Massachusetts Hospital School, Canton, Mass., JOHN E. FISH,
M.D., Superintendent.*

GENTLEMEN: — In response to your request for advice as to the use of water from a deep tubular well near your boiler house, the Commissioner of Health has caused the locality to be examined and samples of the water to be analyzed.

From the information presented, it appears that the well has been driven through from 35 to 50 feet of sand and gravel, then through varying strata of clay and sand to rock, which is reached at a depth of 238 feet. Drilling was then continued into the rock to a total depth of 400 feet.

Water was pumped continuously from this well from Wednesday, October 28, to Friday, December 4, and measurements of the quantity indicate that the yield during this period amounted to about 25 gallons per minute, while larger amounts were pumped occasionally for short periods. The test was made during a very dry period but, considering the fact that the well was being drawn from for the first time, it is not probable that it would yield continuously in a very dry season as great a quantity of water as was pumped during this test. It is probable, however, that the well can be depended upon to yield continuously as much as 15 gallons per minute, or 21,000 gallons per 24 hours, and at times it may possibly yield a somewhat larger quantity. The quantity of water at present supplied from the works of the town of Canton amounts apparently to an average of about 15 gallons per minute, so that the well can probably be relied upon to yield as much water in a very dry period as is now drawn from the water supply of the town of Canton. In wet seasons the yield of the well may be considerably larger than this estimate.

The quality of the water of the well is shown by analyses of two samples, one of which was collected just before the end of the period of pumping. They show that the water, while somewhat hard, contains very little organic matter and is in most respects of good quality for domestic purposes. The quantity of iron, however, is larger than is usually found in good ground waters, though not at the present time sufficient to make the water objectionable for domestic use. There appears to be no objection to the use of this water for the supply of the school at the present time, but there is danger, judging from experience with similar wells, that the quantity of iron will increase and the water become objectionable for some domestic uses. It is advisable, under the circumstances, that the water be analyzed from time to time and, if deterioration should occur due to an increase in the amount of iron, provision can probably be made to filter the water when necessary.

The Department will make the necessary analyses of water, if you so request, as soon as the works for using the water have been installed.

CHICOPEE (WILLIMANSETT).

SEPT. 21, 1915.

TO HON. WILLIAM J. DUNN, *Mayor of Chicopee, Mass.*

DEAR SIR: — In response to a communication to this Department from a resident in the neighborhood of Massachusetts Avenue in Willimansett requesting advice as to obtaining water for the families resid-

ing in that vicinity, the State Department of Health has caused the locality to be examined and a sample of the water from Willimansett Brook, which is said to be used as a source of water supply for several of the families in this region, to be analyzed.

The results of an analysis of the water from Willimansett Brook show that it is badly polluted, and an examination of the surroundings shows that the stream is exposed to pollution. The use of water from this source for domestic purposes is likely to be injurious to the public health, and it is recommended that the inhabitants in the region be warned of the danger of such use.

It is understood that petitions have been presented by inhabitants in this region to the authorities of Chicopee for an extension of the public water supply service of the city to Massachusetts Avenue but that no action has been taken on these petitions. It appears, however, that one of the water pipes of the city of Chicopee passes the westerly end of Massachusetts Avenue, and it is recommended that, pending the laying of a water pipe in this locality, a tap from the city main be provided at some convenient point near the westerly end of Massachusetts Avenue, from which the inhabitants in that region can obtain water for drinking. It is further recommended that, for the protection of the public health, a water main be extended in Massachusetts Avenue at the earliest practicable time.

DALTON.

JUNE 9, 1915.

*To the Board of Water Commissioners of the Dalton Fire District, Dalton, Mass., Mr.
F. G. CRANE, Chairman.*

GENTLEMEN: — The Commissioner of Health received from you on May 13, 1915, an application for approval by this Department of the use of the northerly arm of the Windsor Reservoir as a basin for the storage of water for the public water supply of the town of Dalton, accompanied by a plan of the proposed reservoir and information concerning the area of its watershed.

According to the plan presented, the dam will have a length of about 510 feet and a maximum height of about 28 feet. The top of the dam will be at elevation 1,450, or 2.77 feet above the elevation of the spillway of the main dam of the Windsor Reservoir. The new reservoir will have a maximum depth of water of about 24 feet, an average depth of about 12 feet, and will have a tributary watershed apparently of about 1.6 square miles.

The Department has caused the locality to be examined by its

engineer and samples of water from the Windsor Reservoir and from May Brook, which will be the chief feeder of the proposed new reservoir, to be analyzed. The results show that the water of May Brook is very soft, has little color, and is in other respects of good quality for domestic use.

Regarding the quantity of water which the proposed source will yield, the information at present available indicates that, if the intake at the proposed new reservoir is placed at a level 12 feet below high water, it will probably be capable of yielding about 400,000 gallons per day. If the intake is placed at a level 16 feet below high water, the quantity made available will be increased by about 35,000 gallons per day.

The plan of enlarging the water supply of Dalton by the construction of this reservoir appears to be a practicable and satisfactory one, and by the carrying out of the plan a large additional supply of good water will be secured. Since the surface of the new reservoir will be raised nearly 3 feet higher than that of the present Windsor Reservoir, it is important that all soil and organic matter be removed from the new area to be flowed, and it is also advisable that when the Windsor Reservoir is drawn down to provide for the construction of the new dam any objectionable organic matter that may be found on the bottom above the proposed dam shall be removed or covered in such a way that the quality of the water is unlikely to be affected thereby. There are two dwelling houses within the watershed of the reservoir, both of which are situated not far from the shores of the proposed new basin. The house on the northerly side of the road crossing May Brook just above its entrance into Windsor Reservoir should be controlled by the district in order that pollution of the water by drainage therefrom may be prevented. There does not appear to be danger of serious pollution of the water of the reservoir by drainage from the house on the southerly side of the road at the present time, and it is probable that, with careful supervision, danger of pollution from this house can be prevented. Rules and regulations for the sanitary protection of this water supply will be established by the Department, however, upon request of your board if found desirable.

The Department of Health hereby approves the taking of an additional supply of water for the Dalton Fire District from May Brook and a section of the Windsor Reservoir as shown upon a plan filed in this office May 6, 1915.

DEERFIELD (EAST) (BOSTON & MAINE RAILROAD).

MARCH, 26, 1915.

To Mr. J. H. FLYNN, *Division Superintendent, Boston & Maine Railroad, Greenfield, Mass.*

DEAR SIR: — In response to your request of Feb. 25, 1915, for an examination of certain water supplies at East Deerfield used for the supply of railroad employees in that locality, the Commissioner of Health has caused the sources of supply to be examined and samples of their waters to be analyzed.

The ice house spring, so called, was found to be polluted some time ago, and you were advised that the water was exposed to pollution. Subsequently, the spring was covered and its use prevented for a time, but recently the cover has been removed and the water is again being used. An analysis of the water of the spring shows that it is badly polluted and dangerous for drinking.

The water of the reservoir located a little over half a mile west of the East Deerfield station is also badly polluted and unsafe for domestic use.

The Atwood spring, so called, was examined some time ago and found to be unsafe for use. A further examination does not show any improvement in the conditions affecting this spring.

The Y. M. C. A. house is supplied from a reservoir on a hill about 400 feet from the house and 25 feet above the lower floor. The reservoir was practically empty at the time of the examination and the water being supplied in the house contained a larger number of bacteria than are found in good drinking water. The reservoir is exposed to pollution and is an unsafe source from which to take water for drinking.

There are a number of other open springs in this region which are used for drinking and which are unsafe for that purpose on account of their exposure to pollution. It was also found in the course of the investigation that water from the Deerfield River is supplied for certain purposes at the Holbrook House in these yards. This water is badly polluted and, while it is not intended for drinking, it is probably used at times for that purpose. Much sickness has occurred recently among the employees of the Fitchburg Division of the Boston & Maine Railroad in the neighborhood of East Deerfield and in the region beyond the Connecticut River, and investigations of this sickness point to a source of infection in the neighborhood of the Deerfield yards.

It is of the greatest importance for the protection of the public

health that a supply of safe drinking water be provided for the employees of the railroad in this region and that danger of the use of any of the polluted springs and reservoirs on the railroad property or elsewhere in this section be prevented as effectively as is practicable.

AUG. 26, 1915.

To the Boston & Maine Railroad, Boston, Mass.

GENTLEMEN:— In response to your request, an examination has been made of the water of a tubular well recently put in by you near the roundhouse in the East Deerfield yards, and a sample of the water has been analyzed.

The results of the analysis show that this water is badly polluted and unsafe for drinking and other domestic purposes.

A general examination of the conditions about these yards shows that, so far as can be judged from surface indications, it will be difficult, if not impracticable, to secure a supply of good water in this region by means of wells. It is possible that a supply could be obtained from the higher lands south of the yards by means of a small reservoir or other collecting works, but whether a satisfactory supply could be obtained in this way is doubtful. The best practicable plan of obtaining a supply of good water for the yards appears to be by connection with the water supply system of one of the adjacent towns, and it is recommended that this matter be taken up at once and a supply of good water secured for these yards at the earliest practicable time.

In the course of the examination of the yards at East Deerfield it appeared that the sanitary arrangements for the railroad employees using these yards are inadequate and unsatisfactory, and it is recommended that as soon as a satisfactory water supply has been provided the question of proper sanitary arrangements be taken up.

DUXBURY.

JULY 16, 1915.

To the Board of Health, Duxbury, Mass.

GENTLEMEN:— The State Department of Health received from you on June 30, 1915, the following application for advice as to the quality of the water of certain wells in Duxbury used as sources of domestic water supply.

There are two (2) wells here in Duxbury that there is a question as to whether the water therein is fit for domestic use. If agreeable to you I would like the water therefrom analyzed so as to determine its purity. . . .

In response to this request, the Commissioner of Health has caused the wells indicated to be examined and samples of their waters to be analyzed. The water of the well at the Peterson place, so called, on Powder Point Avenue showed at the time of the examination the presence of considerable numbers of bacteria, though in the condition in which it was found at this time the water may not be unsafe for domestic use. There are sources of pollution in its immediate neighborhood, however, and there is great danger that the quality of the water will deteriorate at any time and become unfit for domestic use. It is recommended that the further use of the water of this well for drinking and other domestic purposes be discontinued.

The water of a well on the Sarah E. Roberts estate on Tremont Street contained at the time of the examination a considerably greater quantity of organic matter than is found in good well waters and a considerable number of bacteria. In its present condition the water may, however, be safe for drinking.

The surroundings of this well are such that it seems probable that, if it were effectually covered and the water drawn through a pump, instead of by a bucket and chain as at present, the quality of the water would improve. It is possible also for waste water to flow back into this well. With more efficient protection, it is probable that the water of this well could continue to be used with safety for domestic purposes.

EASTHAM (WELL).

SEPT. 8, 1915.

To the Board of Health, Eastham, Mass.

GENTLEMEN: — In response to your request, received through Dr. A. S. MacKnight, State District Health Officer, the State Department of Health has caused an examination to be made of the well at the Mayo house, where a case of typhoid fever occurred recently, and has caused a sample of the water to be analyzed.

The results of the analysis of a sample of water collected and sent in by you show that it is low in bacteria and of good quality for domestic use. There is no indication from this analysis that the water would be injurious for drinking.

An examination of the premises shows that there are a vault and cesspool in the immediate neighborhood of the well and, while there is no present evidence that the water is being contaminated, it is advisable that danger of pollution by sewage be prevented by removing the vault and cesspool to a distance of at least 100 feet from the well.

With this change it is probable that the water of the well can continue to be used with safety, provided no sewage or other polluting matter is deposited upon or into the ground in its immediate neighborhood.

EASTON (NORTH EASTON VILLAGE DISTRICT).

JUNE 23, 1915.

TO MR. WILLIAM H. AMES, *Chairman, Board of Water Commissioners of the North Easton Village District.*

DEAR SIR: — In response to your request of May 18, 1915, for an examination of the water of a well located near your pumping station at North Easton and advice as to the use of the water for drinking, the Commissioner of Health has caused the well and its surroundings to be examined by one of the engineers of the Department and samples of the water to be analyzed.

The well, which is known as No. 2, is 8 inches in diameter and 67 feet in depth and is said to have been sunk largely in rock.

The results of the analyses show that the water entering this well has at some time been considerably polluted by sewage but subsequently quite well purified in its passage through the ground before entering the well, and in the condition in which it was found at the time of the recent examination the water is probably safe for drinking. It is not unlikely that the quality of the water will change if water is drawn continuously from this well for the supply of the town, and there is much danger that deterioration in the quality of the water would occur with continued use.

In view of the circumstances, the source cannot be regarded as a desirable one from which to take water for the supply of the town. If it is found necessary to use it, however, provision should be made for frequent analyses of the water in order that if deterioration occurs it may quickly be detected and the further use of the water prevented.

EASTON (SOUTH EASTON AND EASTONDALE FIRE AND WATER DISTRICT).

AUG. 23, 1915.

TO THE BOARD OF WATER COMMISSIONERS, *South Easton and Eastondale Fire and Water District, Mr. WILLIAM N. HOWARD, Chairman.*

GENTLEMEN: — The State Department of Health received from you on Aug. 14, 1915, the following application for the approval by this Department, under the provisions of chapter 232 of the Special Acts of the year 1915, of the taking and use of water from Silver Lake for

the water supply of the South Easton and Eastondale Fire and Water District through a contract with the water commissioners of the city of Brockton made under the provisions of said act.

In order to comply with the conditions of the special act of 1915, chapter 232 in relation to the South Easton and Eastondale Fire and Water District, it becomes necessary to secure a certificate of approval by the State Department of Health of the source of supply and location of dams, reservoir, wells, etc., in compliance with section two of said act.

The South Easton and Eastondale Fire and Water District is under contract with the city of Brockton, which city is furnishing the district with water from its regular supply which is Silver Lake, which source of supply has already been approved and is under constant inspection by the State Department of Health. The attorneys who are passing upon bonds require, however, that a certificate of approval from the State Department be furnished as the law states. . . .

The Department has considered the results of examinations of Silver Lake, the proposed source of supply, by the engineer of the Department and finds that the water is of good quality for domestic use and the supply adequate for the requirements of the South Easton and Eastondale Fire and Water District in addition to those of the city of Brockton and the towns now supplied by that city from Silver Lake.

The State Department of Health hereby approves the use of water taken from Silver Lake and supplied through the works of the city of Brockton for the water supply of the South Easton and Eastondale Fire and Water District under the provisions of chapter 232 of the Special Acts of the year 1915.

EASTON (UNIONVILLE).

Nov. 8, 1915.

To the Board of Water Commissioners of the North Easton Village District, North Easton, Mass.

GENTLEMEN: — At the request of the Unionville Improvement Society of North Easton for advice as to the condition of the wells in Unionville, the State Department of Health has caused the wells used as sources of water supply at ten dwelling houses in various parts of that village to be examined and samples of their waters to be analyzed.

The results of the analyses show that all of these wells are more or less polluted, several of them very seriously, so that in their present condition they are not safe sources from which to take water for domestic purposes. The Department is further informed that in

recent dry seasons many of the wells have furnished an inadequate quantity of water for domestic requirements and that some of them have become wholly exhausted, the latter including the well used to supply the public school in the village.

It appears that there are some ninety families living in the area lying between the northeasterly boundary line of the North Easton Village District and the boundary lines of Stoughton and Brockton and that this locality can be more readily supplied with water from the North Easton Village District than in any other way. The cost of extending works to supply water to Unionville from North Easton would not be excessive, and the amount added to the valuation of the district if its area were extended to include this section of the town would be considerable. The works of the North Easton Village District can be made adequate without special difficulty or expense to supply all of the water required, both to North Easton and the area that would be added if the North Easton system were extended to Unionville.

In view of all the circumstances, it appears to this Department that the most practicable way in which Unionville can obtain a water supply, which is greatly needed for the protection of public health and comfort in that village, is by connection with the water works system of the North Easton Village District, and it does not appear that such an extension would be seriously objectionable to the latter district, either from a financial standpoint or in any other respect.

The Department will be pleased to confer with you relative to this matter at the earliest practicable time, since it is very important that the inhabitants of Unionville shall be enabled to provide themselves with a suitable system of water supply for domestic use, and if such a supply can be obtained from the North Easton Village District the necessary legislation can be obtained at the coming session of the Legislature.

ENFIELD (SPRING).

Nov. 6, 1915.

To the Board of Health, Enfield, Mass.

GENTLEMEN: — In response to a request for an examination of the water of the spring used to supply the house of Mr. George Horr of Enfield and advice as to its quality for drinking, and especially as to its liability to cause lead poisoning, the State Department of Health has caused the spring and its surroundings to be examined and a sample of the water to be analyzed.

The spring is located in an unpolluted region and the water is

naturally of good quality for domestic use. Samples of the water collected from a faucet in the house of Mr. Horr, however, showed the presence of a very large quantity of lead, both in the standing and in the running water. The water also contained a comparatively large quantity of carbonic acid for several days after the sample was collected. The quantity of lead found in these samples was ten times as great as the minimum amount that has been known to cause lead poisoning, and it is recommended that the use of this water, both for drinking and cooking, be discontinued until a pipe of some suitable material can be laid in place of the lead pipe now in use.

Pipes of block tin or of lead lined with tin, if properly made, or of iron lined with cement could be used with this water and danger of lead poisoning avoided, though it would be essential, if a lead pipe lined with tin were used, that the portion of the pipe which enters the spring should be wholly of tin or of iron.

If a change is made in the character of the pipe and a pipe such as those suggested is used, the water of this spring would be safe for drinking.

ESSEX (TOWN FARM).

MARCH 8, 1915.

TO MESSRS. CALEB M. COGSWELL, JOHN P. STORY and GEORGE S. MCINTIRE, *Board of Selectmen, Essex, Mass.*

GENTLEMEN: — In response to your request of Feb. 19, 1915, the Commissioner of Health has caused the water supply on the Town Farm to be examined and samples of the water to be analyzed.

The results of the examination show that the supply is obtained from two large wells near the Conomo Point Road, the old well, so called, being located about $\frac{1}{4}$ of a mile southeast of the Town Farm, and the new well about 400 feet farther south. There are no dwelling houses or other buildings in the neighborhood of the wells.

The information submitted indicates that the water is supplied to about seventy-five cottages, occupied only in summer, and to a few other buildings, the population supplied in summer being about 750 persons, while the number using the water in winter is very small. The water is pumped to a tank holding about 50,000 gallons and distributed through a galvanized iron pipe.

The results of the analysis of a sample of water collected recently from a tap at the Town Farm show that the water is turbid and colored and contains a much greater quantity of iron than is found in good well waters. In its present condition, the water is probably safe for drinking, but the quantity of iron present is great enough to

make the water objectionable for some domestic uses. It is advisable that a further examination of this water be made in the summer season in order that the condition of the water may be determined at a time when the draft from the wells is greatest.

FALL RIVER.

FEB. 2, 1915.

To the Reservoir Commission, Fall River, Mass.

GENTLEMEN: — The State Department of Health received from you on Nov. 9, 1914, the following application for approval of the purchase or taking of certain lands in the town of Westport for the purpose of protecting the water supply of the city of Fall River:

The Reservoir Commission of the City of Fall River respectfully make application to the State Department of Health under the laws of the year 1908, chapter 499, entitled "An Act to provide for the Protection of Sources of Water Supply," namely, — to acquire by purchase or otherwise lands in the Town of Westport on the easterly side of North Watuppa Pond. The said pond being the water supply of the City of Fall River. These lands are within the watershed of the said pond and at present are a danger and a menace to the purity of the water supply of the said city. We annex hereto plans and description of said lands.

The Commissioner of Health has caused the lands in question to be examined and, in accordance with the provisions of chapter 499 of the Acts of the year 1908, the Public Health Council gave a hearing upon the petition at its office, Room 143, State House, on Jan. 26, 1915, after notice published in newspapers of the city of Fall River and circulated in the town of Westport. At this hearing no person appeared to object to the proposed purchase or taking of the lands in question by the city of Fall River for the purpose of protecting its water supply.

From the information presented, it appears that these lands are within the drainage area of North Watuppa Pond, the source of water supply of the city of Fall River, and that they are now occupied in part by piggeries or used for the disposal of refuse in such a way that there is danger that the water supply of the city may be polluted therefrom.

After the hearing, the Public Health Council voted to approve the purchase or taking of the lands in question, consisting of four parcels now or formerly owned by Arthemise M. Freelove, Mary Sumler and Jonathan Borden, the location of which is shown upon the plan filed

with your application entitled "Reservoir Commission Fall River, Mass. Plan showing Lands in North Westport Mass. Supposed to be Owned by Arthemise M. Freelove, Mary Sumler and Jonathan Borden. To accompany petition of City of Fall River for authority to acquire lands in Westport. Scale: 1"=200' Nov. 2, 1914 City Engineering Dept. R. C. No. 40." These lands are bounded, measured and described as follows:

. . . Beginning at the southwesterly corner of the land to be described at a drill hole in the top of a stone bound set into the ground about Three Hundred and twenty (320) feet easterly of the easterly line of the Ancient Proprietor's Way leading northerly from the "Old Bedford Road" so called; said point being the Fifth (5th) bound stone, mentioned in the record of condemnation of land in Westport by the Reservoir Commission of the City of Fall River, March 7, 1896 and thence in the recorded line of said condemnation by land of said City of Fall River, in a course North Forty-Eight (48) degrees Twenty-four (24) minutes Forty (40) seconds East Five Hundred and Fifty and Fifty-four One Hundredths (550.54) feet or to a drill hole in the top of a stone bound set into the ground, being the Sixth (6th) bound stone mentioned in said condemnation; thence by land of Said City in a course North, Eleven (11) degrees Fifty-five (55) minutes Thirty (30) seconds East Four Hundred and Thirty-one and Eighty One-hundredths (431.80) feet or to a drill hole in the top of a stone bound set into the ground, being the Seventh (7th) bound stone mentioned in said condemnation and in the southerly line of land now or formerly of Thomas Francis for a corner; there making an interior angle of about Ninety (90) degrees and running in an Easterly direction by said last named land about Three Hundred and Seventy (370) feet or to land now or formerly of Albert S. Sherman for a corner; there making an interior angle of about Ninety-two (92) degrees and running in a southerly direction by land last named and land of the City of Fall River (formerly owned by Thomas B. Sherman) about Eight Hundred and Seventy-four (874) feet or to land now or formerly of Cynthia M. Wordell, for a corner; there making an interior angle of about Eighty-eight (88) degrees and running in a Westerly direction by land last named about seven Hundred (700) feet or to the point of beginning.

The above described tract contains about Three and Sixty-two One Hundredths (3.62) Acres of land now or formerly owned by Arthemise M. Freelove, about One and Ninety-two One Hundredths (1.92) Acres now or formerly owned by Mary Sumler and about Three and Sixty-Seven One Hundredths (3.67) Acres now or formerly owned by Jonathan Borden in which Arthemise M. Freelove has certain title.

The above description is approximate, some of the distances, angles and areas being scaled from a plan and is subject to revision from surveys to be made if the land is to be acquired.

SEPT. 2, 1915.

To the Watuppa Ponds and Quequechan River Commission, Fall River, Mass., Messrs.
PHILIP D. BORDEN, CHARLES B. WOODMAN, JOHN W. COUGHLIN, DANIEL J.
SULLIVAN, WILLIAM B. HAWES.

GENTLEMEN: — The State Department of Health received from you on Aug. 27, 1915, the following application for the approval of certain plans for improvements in the sanitary and other conditions in the valley of the Watuppa Ponds and Quequechan River in the city of Fall River.

The Watuppa Ponds and Quequechan River Commission, acting under authority of chapter 767, Acts of 1913, and of chapter 238, Acts of 1914, and chapter 367, Special Acts of 1915, in amendment thereto, is

. . . authorized and directed to cause a careful investigation of the whole subject of the nuisances in and along the line of the Quequechan river or upon or about lands or flats or waters adjacent or near to said river, and of the needs of the city for the increase, purification, protection and control of its water supply and the conservation and improvement of the waters of the Watuppa ponds and of all brooks, streams and water sources contributing thereto; and to make necessary surveys and examinations and prepare and submit to the state board of health for its approval, comprehensive plans, showing in detail full and complete methods for abatement of the nuisances aforesaid, for the control and direction of the waters of the Quequechan river, for proper drains for surface water and sewers for sewage, and for the increase, purification, protection and control of the water supply of the city.

In accordance with these acts detailed plans have been prepared under the direction of this Commission by its consulting engineers, Fay, Spofford and Thorndike, Boston, for the abatement of the nuisances aforesaid and for the protection, control and direction of the waters of the South Watuppa Pond and the Quequechan River including such drains for surface water and sewers for sewage as appear necessary for these purposes. From time to time, during the progress of our work, our engineers have submitted preliminary plans to the Chief Engineer of your Department, and have held conferences with him in order that we might secure the benefit of his criticisms and advice and be sure that the work was being carried out along lines satisfactory to your Department.

In our original scheme for the improvement it was proposed to conserve the surface water draining into the Quequechan River by discharging it into the South Watuppa Pond. At a conference on August 3, 1915, representatives of your Department informed our engineers of their decision that, to prevent further pollution of the waters of the South Watuppa Pond, arrangements should be made by which this surface water can ordinarily be discharged into the Taunton River. Our plans have accordingly been revised so that this may be done, and a complete set in final form was filed with your Department by our engineers on August 20, 1915.

The Commission now respectfully suggests the formal approval of these plans by your Department.

In connection with the application, plans and descriptions of the proposed works have been filed by your engineers showing (1) a main conduit to be constructed from the vicinity of the Sand Bar at the outlet of South Watuppa Pond along the Quequechan River to a point just above the Watuppa Dam to provide for the flow of the river and for the supply of water to the mills for condensing, washing and other purposes; (2) a system of sanitary sewers discharging into tide water to take the sewage and wastes from the mills which are now discharged more or less directly into the stream; (3) a system of surface water drains to relieve the existing overtaxed combined sewers, thereby making practicable the discontinuance of overflows from these sewers which at present discharge into the Quequechan River at Plymouth Avenue and Quequechan Street; and (4) the filling of certain areas of flats on either side of the proposed conduit to a height at least equal to full pond level of the South Watuppa Pond.

The State Department of Health has caused the Watuppa Ponds and Quequechan River to be examined and numerous samples of their waters collected at various points to be analyzed in connection with the investigation of this proposed work and has carefully considered the plans and estimates of cost now presented for its consideration.

The analyses show that, while the waters of South Watuppa Pond are of good quality, the waters of the Quequechan River show rapidly increasing pollution below the South Pond, and in the drier portion of the year the river is grossly polluted throughout much of its course. These conditions are worse during the warmer and drier portion of the year when, by the drawing down of the pond and the lowering of the water in the river, extensive flats in its neighborhood covered with deposits from sewage are exposed. Growths of organisms of various kinds take place on the flats and in the water and increase the nuisance. The nuisance is further aggravated by the fact that the water of the river is used very largely for the cooling of engines and, in consequence, its temperature is raised to a high degree in the drier portion of the year.

It is essential for the protection of the health of the people of the city that these objectionable and unsanitary conditions be removed as soon as practicable. The problem involves also other considerations which, in the interest of the continued prosperity of the city, require a material change in the condition of this river. On account of the high temperature to which the water is raised in the summer season, its value for cooling is rapidly growing less, while, on account of the pollution of the water, its use for mechanical and manufacturing purposes is also becoming unsatisfactory. Furthermore, the pres-

ent channel of the river is of an insufficient depth to make available for use the great quantity of water that can be made available from these ponds.

Information submitted as to the flow of the Quequechan River indicates that it falls as low as 8 million gallons per day and sometimes to smaller quantities in dry years, whereas with a deeper channel and better regulation a constant flow of 20 million gallons, or possibly somewhat more, can be maintained at all times, including the driest years.

The plans now presented by your commission are designed to abate the nuisance existing in the valley of the river and to secure the full value of this water supply for the industries of the city by providing for the complete separation of the hot and cold water, by permitting a constant supply of cold water much larger than the present minimum flow of the river to be discharged down stream in dry seasons, by providing an ample supply of cold water to all the principal mills along the stream by making available water stored in the South Pond at depths lower than that to which it is now possible to draw the pond, and, finally, by providing for the return of the hot water from the mill condensers to the South Pond, where it will be cooled and made available for further use. The plans provide for a main conduit consisting of a single structure with three separate channels superimposed on each other, to be laid along the present line of the Quequechan River south of the New York, New Haven & Hartford Railroad from the Sand Bar, so called, at the outlet of South Watuppa Pond to a point about 350 feet above the Watuppa Dam. In this conduit the cold water channel is placed at the bottom, and the hot water channel at the top of the structure, and between the two is a surface water channel for the removal of the storm water from the watershed draining to the Quequechan River in this region to an outlet below the Watuppa Dam. The inlet for cold water and the outlet for hot water are widely separated, and provision is made at the outlet of the hot water conduit for separating any oil that may become mingled with the hot water before it is discharged into the pond. Provision is also made for turning the hot water into either the surface water channel or the cold water channel in case of need for the prevention of interference by ice. There is also provision for an overflow into the South Pond from the surface water channel in case the latter should become surcharged in an excessively heavy rain. At the lower end of the conduit near the Watuppa Dam, structures are provided for the discharge of water down the old channel of the river, which is estimated to have a carrying capacity of about 250

cubic feet per second, and a new outfall sewer having a capacity of 535 cubic feet per second is to be provided for the removal of sewage and storm water. This new sewer can also be used in emergencies for the removal of flood waters from the South Pond.

The plans of sewerage and drainage submitted with the application provide for the separation of the sewage from the storm water in the valley of the Quequechan River and for maintaining separate systems in this valley in the future. In the beginning, however, it is only proposed to construct such sewers as are necessary to effect a partial separation, and especially to reduce and practically prevent the overflow of mingled sewage and storm water into the Quequechan River. The plans provide for conveying the sewage to tide water through the proposed new outfall sewer previously referred to, having a capacity of 535 cubic feet per second, at the lower end of which outlet pipes are to be provided, one to discharge the higher flows below high water, while the other will convey the dry weather flow of sewage to an outlet in the Taunton River at a depth of 35 feet below mean high water.

The plans as a whole, in the opinion of the Department, provide adequately for removing the nuisance in the valley of the Quequechan River, for providing proper sewerage and drainage systems in this valley, for conserving the waters of the Watuppa Ponds, and for securing to the city certain other very important improvements, and the plans are hereby approved.

It is necessary, in the opinion of the Department, that provision be made in the construction of these works and in their operation to prevent danger of an injurious flood in this valley by making further provision for the temporary storage or disposal of flood waters. Past experience has shown that the North Pond has risen as much as $14\frac{1}{2}$ inches in a single day, and, with the changes that are being made by the diversion of water from the watershed of the North Pond to the South Pond, there is danger that the water in the South Pond will rise to a greater height in a future similar flood, especially if the North Pond should happen also to be full at the time of its occurrence. Such floods probably do not occur oftener than once or twice in a century, but it is nevertheless important to guard against the danger of serious damage from such an occurrence, and it is recommended that provision be made for allowing the water of the South Pond to rise temporarily above full pond to a level which would be equivalent to approximately the storage in the upper two feet of the South Pond. It will probably be practicable to provide for such an emergency without causing serious expense if arrangement for such

an occurrence is made in the near future. If it is not found practicable to allow the water to rise to so great a height without causing serious damage, the level of the South Pond should be kept sufficiently below full pond to provide for such a flood.

The Department also advises that all pollution, so far as practicable, be kept out of the South Pond since this water, if unpolluted, will continue to be of good quality, while, if allowed to become polluted, objectionable organic growths would be likely to appear which would make the condition of the lake objectionable, and the quality of the water might become seriously impaired for manufacturing and other uses. It is furthermore possible that water from the South Pond may be required at some time in the future for the domestic water supply of the city of Fall River. The consumption of water in the city is increasing steadily, and in the past few years quite rapidly, and with the recent reduction in its drainage area the quantity of water drawn from the North Pond will soon equal the yield of that source in a series of very dry years.

Since final plans for increasing the water supply of the city have not yet been selected, the South Pond should be kept in such condition that its waters may be used temporarily or permanently for that purpose with as little expense as practicable for the removal of sources of pollution.

DEC. 10, 1915.

To the Watuppa Water Board, Fall River, Mass.

GENTLEMEN: — The State Department of Health received from you on Dec. 8, 1915, the following communication requesting its advice as to permitting the cutting and harvesting of ice on North Watuppa Pond.

The Watuppa Water Board is about to issue permits for the cutting and harvesting of ice on the north pond and I am directed to send you a copy of the permit containing various rules and regulations for the protection of the water during the time of such cutting and harvesting.

Will you please look these rules and regulations over and advise us if they meet with your approval and if not to suggest to us other rules and regulations which in your opinion will best protect the pond from pollution.

Kindly give this matter your earliest attention. . . .

The question of the practicability of harvesting ice on North Watuppa Pond was carefully considered by this department in the winter of 1914 when ice cutting was carried on there presumably under the most careful inspection by your department, as recommended by this Department in its communication of Jan. 10, 1914.

In spite of this careful inspection, the results of the examination by this Department at that time showed that the pond was being badly polluted, as stated in its communication to you of April 13, 1914, as follows:

. . . Samples of water were taken for bacterial analysis at points along the shores, all of them showing pollution, and at one place where ice was being harvested the water on the top of the ice of the pond was found to contain 850,000 bacteria per c. c., including many of those characteristic of sewage.

These conditions occurred in spite of the employment by your department of numerous inspectors to prevent the pollution of the pond or its watershed, and the results show clearly the impracticability of preventing the pollution of a water from which ice is harvested in considerable quantities. It may be added that similar conditions were found on several other water supplies during the past winter from which ice is harvested in considerable quantities for domestic purposes and where inspection is also provided by the city or town to prevent pollution of the water. The results, in the opinion of the Board, are conclusive. They show that it is impracticable to protect adequately the purity of the water of North Watuppa Pond and continue to use it as a source of ice supply. . . .

In the opinion of the Department, the proper protection of the health of the inhabitants of the city of Fall River requires that the cutting of ice from North Watuppa Pond as practiced in the past shall be discontinued. If your board decides to again grant permits for the cutting or harvesting of ice from this pond, notice should be given to all the inhabitants of the city to boil all water used for drinking while ice cutting is in progress and to continue to do so until the end of six weeks after ice has disappeared from the pond.

Full copies of the communications of this Department of April 13, 1914, and of Dec. 31, 1914, are appended hereto and made a part of this communication.

DEC. 27, 1915.

To the Watuppa Water Board, Fall River, Mass., Mr. JAMES J. KIRBY, Clerk and Registrar.

GENTLEMEN:—The State Department of Health has considered your letter of Dec. 15, 1915, in reply to its communication of December 10 relative to the cutting of ice on North Watuppa Pond, the source of water supply of the city of Fall River.

The Department has not advised you as to the rules and regulations which you submitted for the protection of the water during the time of ice cutting, because experience has already shown that inspection is ineffective and inadequate for the protection of the purity of the water.

This experience was acquired during the period of cutting ice under the inspection of your department in the winter of 1913-14. At that time the process was inspected by employees of this Department, and conditions were found which showed that the pond was being grossly polluted during the period that ice cutting was carried on. These conditions were reported to you in a communication from this Department dated April 13, 1914, and have been repeated in subsequent communications.

Considering the gross pollution that resulted from the cutting of ice on North Watuppa Pond under your inspection at that time, the Department can see no justification whatever for placing in jeopardy the lives of the inhabitants of the city by a continuation of the use of the pond for that purpose.

Since the powers delegated to your board to permit the cutting of ice on the sources of your water supply must be exercised subject to such recommendation and direction as shall be given from time to time by this Department, and since this Department has repeatedly recommended that such permits be not granted, it now directs that they shall not be granted by you for such ice cutting, and hence the powers delegated to you to grant any such permit no longer exist.

FALMOUTH.

MAY 24, 1915.

To the Board of Water Commissioners of the Town of Falmouth, Mass.

GENTLEMEN: — In response to your request for an examination of the water supplied to Falmouth from Long Pond and advice as to the cause of the objectionable condition complained of by water takers at the present time, the Commissioner of Health has caused the pond to be examined and samples of the water to be analyzed.

The results of the examination show that the water of Long Pond contains at the present time large numbers of the organism *Uroglena* which is the cause of the objectionable taste and odor in the water. While the presence of this organism in large numbers makes the water very objectionable, the use of water under these conditions is not known to be injurious to health. Complaint caused by the presence of the organism *Uroglena* generally occurs during cold weather, and the condition of this organism in the pond at the time of the recent examination and its absence from the samples collected from taps in town indicate that the growth is diminishing in intensity and will probably disappear as soon as the temperature of the water increases. Experience at other places indicates that less complaint is likely to occur if the flushing of pipes is omitted until the organism has disappeared from the waters of the pond.

FITCHBURG.

JAN. 12, 1915.

TO MESSRS. THOMAS C. SHELDON, ARTHUR A. TRAIN and FRANK H. FOSS, *Board of Water Commissioners, Fitchburg, Mass.*

GENTLEMEN: — The State Department of Health received from you on Nov. 11, 1914, the following petition for approval by this Department, under the provisions of chapter 697 of the Acts of the year 1914, of the taking of certain sources of water supply in Ashburnham and Ashby:

By chap. 697, Acts of 1914, this city is authorized to increase its water supply by the building of reservoirs on the Falulah brook watershed at Shattuck's and Lovell's sites, so called, take and develop Ashby reservoir in the town of Ashby and also Watatic, Ward, Stodge Meadow and Rice ponds with the Souhegan river in the towns of Ashby and Ashburnham according to plans formulated by Metcalf & Eddy, Boston.

This is all subject to the approval of the Massachusetts Department of Health.

By the act we are required to take Ashby reservoir within one year of its passage, which will be by June 1915, so it seems best to us in view of this fact and the financial condition of the city that we rebuild at once the dams at Ashby reservoir to raise the high water mark to an elevation of 13 feet (elevation 1,007 above sea level) above the present high water mark, storing about 747,000,000 gallons.

Following this to construct a reservoir at Shattuck's on Falulah brook to hold about 300,000,000 gallons with high water mark at elevation of 905 above sea level.

We have these surveys and plans nearly finished and ask that you look over the sites and reservoirs as per our plans and if satisfactory give your approval.

The application was accompanied by a plan showing the present outlines of the Ashby Reservoir, its outline when raised 13 feet to elevation 1,007 above sea level, and an area of land not exceeding 5 rods in width to be taken about the reservoir when raised as proposed. It appears, from the information presented with the application, that it is proposed to reconstruct the Ashby Reservoir at the present time by building two new dams and to divert its waters into Falulah Brook and subsequently into a new reservoir to be known as Shattuck Reservoir, to be constructed on Falulah Brook with a high water mark at elevation about 905 above sea level.

As to the treatment of Ashby Reservoir in preparation for the storage of water for domestic purposes, it is understood that you propose for the present simply to clear thoroughly the additional land which

will be flowed by raising the reservoir and that no further preparation will be made at the present time. The water of Ashby Reservoir will for the present, and until the construction of the Shattuck Reservoir, be drawn into Falulah Brook and will flow in this brook a distance of approximately 2 miles to the Falulah Reservoir, whence it will be drawn for the supply of the city. After the construction of the Shattuck Reservoir, the water will flow into that reservoir a distance of nearly a mile and thence in part to Falulah Reservoir and in part to the Scott Reservoir, which supplies the high-service system.

Ashby Reservoir has a muddy bottom and there is little doubt that when flowed to the new high water level under the plan proposed the water will at times be objectionable in appearance, taste and odor for domestic use. It will be necessary, however, for the Ashby water to flow a long distance in Falulah Brook, and its quality will no doubt be improved thereby. In case it should still be objectionable at times, the use of the reservoir can be avoided when desirable by utilizing the water of the other sources. The circumstances are such, moreover, that if it is ultimately found advisable to improve further the bottom of this reservoir, it can be isolated from the system and the work can be carried out when necessary. If, however, part of the material required for the construction of the dams can be obtained by stripping parts of the area to be flowed without adding greatly to the cost, it would be best to strip as much of the new area to be flowed as may be found practicable for this purpose.

The State Department of Health has considered your application and the plan presented and hereby approves the taking of Ashby Reservoir as a source of supply for the city of Fitchburg and also the taking of land about the shores of the proposed reservoir as shown upon the plan presented. The Department also approves the location of the dams at this reservoir as shown upon the plan submitted.

AUG. 27, 1915.

To the Board of Water Commissioners of the City of Fitchburg, Mass.

GENTLEMEN:—The State Department of Health has considered your application received on Aug. 6, 1915, for the approval by this Department of the purchase or taking by the city of Fitchburg, under the provisions of chapter 697 of the Acts of the year 1914, of certain parcels of land in the neighborhood of the Ashby Reservoir and the pipe line leading therefrom to Falulah Brook, shown on plans submitted with the application, and has caused the parcels indicated to be examined by its engineer.

It appears from the examination that these parcels in some cases

contain buildings, drainage from which would tend to pollute your water supply, and in other cases are so located that it is important for the city to control them for the protection of the purity of the water in the reservoir.

After consideration, the Department voted to approve the taking of the lands in question as shown upon the plans filed with your application which bear the following titles: — (1) "Fitchburg Water Works, Fitchburg, Mass. Ashby Reservoir Showing Area Flowed 5-rod Taking and Adjacent Property. Nov. 1914. Scale 1 in.=200 ft."; (2) "Land owned by Henry B. Houghton near Ashby Reservoir. July 1915. Scale 1 in.=200 ft."; (3) "Land owned by Levi W. Mayo near Ashby Reservoir. July 1915. Scale 1 in.=200 ft.", these plans having been filed in this Department on Aug. 6, 1915.

FRAMINGHAM.

FEB. 26, 1915.

To the Board of Water Commissioners, Framingham, Mass.

GENTLEMEN: — In response to your request for advice as to the probable effect of the water supplied to the town of Framingham upon lead pipe if used for services, the Commissioner of Health has caused the sources of supply to be examined and samples of Framingham water placed in contact with lead service pipes to be analyzed.

It is understood that the water supply of Framingham is drawn in part from the filter gallery near Farm Pond and in part from the Sudbury Aqueduct, the greater portion of the water at the present season of the year coming from the filter gallery.

The results of the test show that this water when standing in contact with new lead service pipes for a period of a few hours takes up a quantity of lead much in excess of the minimum quantity known to have caused lead poisoning. Under the circumstances the use of lead pipe in connection with this water will involve danger of injury to health.

FRANKLIN (WELLS).

AUG. 14, 1915.

To the Board of Health, Franklin, Mass., Mr. J. NEWTON BLANCHARD, Agent.

GENTLEMEN: — In response to your request the State Department of Health has examined the water of two wells in Franklin, — one located on the property of Miss Frances King on High Street and the other at the corner of West Central and School streets, — for the purpose of advising as to the safety of these sources for domestic use.

The results of an analysis of the water from the well on the King place show that, while some of the water entering the well had probably been polluted, it was quite well purified in its passage through the ground before entering the well, and in the condition in which it was found at the time of the examination was probably safe for drinking. There are sources of pollution at no great distance from this well, however, and considering the circumstances it is not advisable to use the well as a source of domestic water supply.

An examination of the water of the well located at the corner of West Central and School streets shows that this water has been very badly polluted and the source cannot be regarded as a safe one from which to take water for domestic use.

It appears that the public water supply of the town of Franklin is available for use on both these premises, and it is recommended that water from the public supply be provided and the further use of water from these wells discontinued.

GEORGETOWN.

MAY 17, 1915.

To the Board of Selectmen, Georgetown, Mass.

GENTLEMEN: — The Commissioner of Health has considered your application for advice as to a proposed water supply for the town of Georgetown and has caused the locality to be examined by the engineer of the Department.

The results of an examination show that the conditions affecting the water supply for Georgetown have changed very little since the time of the previous consideration of this question in 1897. The two ponds located close to the village, Rock Pond and Pentucket Pond, are each of them of ample capacity to supply a much greater quantity of water than would be required for the uses of Georgetown, but the waters of these ponds are highly colored and affected by growths of organisms and would be objectionable for domestic use. While the water of these sources might be purified, there is no doubt that a ground water supply, if a suitable source can be found within the limits of the town, would be far more desirable than the water of any of the available surface sources, even after purification.

A careful examination of the region about Rock and Pentucket ponds shows that, judging from surface indications, the conditions are probably favorable at several points in the neighborhood of these ponds for obtaining water from the ground by means of tubular wells or other suitable collecting works. The most favorable of these loca-

tions, so far as can be judged from a surface examination, is in the neighborhood of the Parker River just above the point where it is crossed by the highway near Rock Pond. The land close to the river in this region is meadow and may contain a considerable depth of peat, which might have an unfavorable effect upon the water of wells located in this ground, but a few hundred feet back from the river on the northerly side, there are gravelly or sandy lands where the conditions appear to be favorable for obtaining water from the ground. A similar condition exists on the south side of the river, though this location may be a somewhat greater distance from the town than the north side of the stream. Favorable conditions are also found in the neighborhood of Pentucket Pond, especially on its southwesterly side, where the soil appears to be very coarse and porous, but several cottages have been constructed in this region and the cost of works here might be greater than in the location mentioned above. It is also possible that the water of wells near the southwesterly side of Pentucket Pond might be affected by the nearness of the population in the village. The conditions are also apparently favorable for obtaining water from the ground along the southwesterly side of Rock Pond, though the number of cottages in this region might make it difficult to obtain a satisfactory supply without a greater expense than would be necessary in the case of lands northwest of the pond. There are also other localities in which it seems probable that a ground water supply can be obtained in considerable quantity.

It is recommended that as your next step in making investigations for a water supply for Georgetown tests be made by sinking wells first in the neighborhood of the Parker River above Rock Pond and, if the results are unsatisfactory there, that they be continued in other locations where favorable conditions are found. If a location is found where the test wells penetrate a porous soil which yields water freely, the tests should be continued to determine whether these conditions extend over a considerable area, and samples of the water should be examined to determine its suitability for domestic use. As soon as a location is found in which water is obtained freely from the test wells, it will probably be advisable to make a further test by pumping from a group of wells at such a rate and for such a length of time as may be necessary to determine the suitability of the source for the requirements of the town of Georgetown. In case you decide to make further investigations, the Department will assist you by making such analyses of the water as may be necessary, and when the results of tests are available will give you further advice as to a source of water supply for the town.

GREENFIELD.

Nov. 29, 1915.

*To the Board of Water Commissioners, Greenfield, Mass., Mr. GEORGE F. MERRILL,
Superintendent.*

GENTLEMEN: — The State Department of Health has considered your application for advice as to a proposed extension of your filter designed for filtering Green River water into the well near that stream and has caused the locality to be examined by one of its engineers and samples of the soil at the site of the proposed filter to be analyzed.

The plan now proposed provides for enlarging the filter bed near the well by extending the area on the side toward the well for an average width of about 24 feet so that the southerly edge of the filter will be at all points about 80 feet distant from the well. It is also proposed to lay a pipe along the edge of the filter nearest the well about $1\frac{1}{2}$ feet beneath the surface of the filter and about 5 feet below the adjacent ground between the filter and the well, through which it is proposed to discharge water from Green River into the ground during the winter season only, since it is found that cold weather interferes considerably with the operation of the present open filter bed.

The results of the analyses of the material from two test pits within the limits of the proposed extension of the filter show that the soil in these test pits is a coarse gravel containing many large stones, mingled, however, with fine material apparently in sufficient quantity to produce an effective size of sand ranging from .26 to .32 of a millimeter, which, if generally continuous throughout the area between the filter and the well, should produce an effective filter.

The proposed pipe line from which water is to be discharged into the ground beneath the edge of the filter is to be laid with open joints, and it is probable that water will filter freely into the ground for a time. There are times, however, when Green River water carries considerable silt, and it is likely that the amount of water that will filter into the ground will diminish in the future, and it may be necessary in time to take up, clean and relay the distribution pipe in order to insure its satisfactory operation. If the proposed pipe line operates satisfactorily and if it is found that the water is satisfactorily purified when applied to the ground in this way, the capacity of the works in the winter season may perhaps be still further increased and the saturation of the ground be made more effective by laying additional distribution pipes beneath the surface of the open filter which can be used in the cold weather. It is important of course that the sub-

surface distribution pipes be used only when necessary in winter and the open filter used at other times.

You have also requested advice as to covering the open filter with a layer of finer material in order to prevent the clogging of the filter by silt, which is sometimes present in a considerable quantity in the river water. The analysis of a sample of sand sent in by you from a sand bank southwest of the filter shows that it has an effective size of .29 of a millimeter, and this sand would be of excellent quality for filtration.

In the opinion of the Department, by covering the filter with this sand, it will be practicable to scrape it at the necessary intervals and secure its efficient operation with less difficulty than under present conditions.

HANOVER.

MAY 14, 1915.

To the Water Supply Committee of the Town of Hanover, Mass., Mr. FRED W. PHILLIPS, Chairman.

GENTLEMEN: — The Commissioner of Health received from you on April 13, 1915, through your engineer, Mr. E. Worthington of Dedham, an application for advice as to a proposed source of water supply for the town of Hanover, to be taken from the ground by means of tubular wells or other works to be located in the neighborhood of Silver Brook near the point where it joins Third Herring Brook in the northeastern part of the town of Hanover, and in response to this application has caused this locality to be examined by the engineer of the Department and samples of water from test wells in this locality to be analyzed.

The information furnished by sinking test wells at several points in this region shows that the wells in most cases penetrated a porous stratum from which water could be drawn quite freely, and the indications are that this porous stratum may extend over a considerable area in this neighborhood. The watershed draining toward this locality is quite extensive and, so far as can be judged from the tests thus far made, the indications are favorable for obtaining enough water from the ground in this region for all the requirements of the town of Hanover.

Analyses of samples of water from several of the test wells indicate that the ground water in this region is likely to be of good quality for domestic use. There are no sources of pollution in the region in which the test wells were located which appear likely to affect unfavorably

the quality of the water taken from the ground, and the location appears to be as favorable a one as it is practicable to secure from which to take water for the supply of the town.

In view of the favorable results of the preliminary investigation, it is recommended that a further test of the practicability of obtaining an adequate supply of good water for Hanover be made by sinking a number of wells in this locality and pumping from them at a rate of at least 300,000 gallons per day for a period of at least ten days. It is important that the water pumped during the test be carefully measured and that it be disposed of by discharging it into the brook at a sufficient distance below the wells to avoid danger of its affecting their yield. It is also important that careful observations of the fluctuations in the ground water level be made before, during and after the period of pumping and that samples of water be collected for analysis at frequent intervals during the test.

When you are ready to proceed with this test, the Department will make the necessary analyses of water and will give you further advice as to taking a water supply for the town of Hanover from the ground in this region as soon as the results of further tests are available.

HARWICH (WELLS IN HARWICH CENTER).

FEB. 27, 1915.

To the Board of Health, Harwich, Mass.

GENTLEMEN: — In response to a request for an examination of certain wells in the village of Harwich Center in which a number of cases of typhoid fever recently occurred, the Commissioner of Health has caused certain of the wells to be examined and samples of their waters to be analyzed.

The results of the analyses show that all of the wells examined contained a larger quantity of iron than is found in good well waters, which makes them objectionable for many domestic uses. This condition has been found in all of the wells examined in this village.

The results of an analysis of the water of the well on the premises of H. H. Murphy indicate that it is badly polluted and unsafe for use.

The well in the rear of the Highland Hotel is also very badly polluted and cannot be regarded as a safe source from which to take water for drinking.

The water of the wells on the premises of John H. Drum and C. F. Smyser shows no marked evidence of sewage pollution, but these waters contain a larger quantity of organic matter than is found in

good well waters and are affected by an excess of iron which makes them objectionable for domestic use.

A general water supply is very greatly needed in this village, and it is recommended that the town cause an investigation to be made at the earliest practicable time with a view to obtaining a general water supply for domestic purposes. The Department will assist you in making investigations for a water supply, if you so request, by making examinations of any sources which you may desire to have considered and will advise you as to any plan for a system of water supply that you may desire to present. Many towns having less population and valuation than the town of Harwich are already provided with public water supplies, and the Department will be pleased to supply you with information concerning them, if you wish.

IPSWICH.

JAN. 18, 1915.

To the Municipal Water and Light Commission, Ipswich, Mass., Mr. GEORGE A. SCHOFIELD, Chairman.

GENTLEMEN: — In response to your request for an examination of the water of Bull Brook and advice as to its use as a temporary source of water supply by the town of Ipswich, the Commissioner of Health has caused the brook and its watershed to be examined and a sample of the water to be analyzed.

The results of the examination show that the water of Bull Brook, above the point at which you propose to take it for the water supply of Ipswich, is not exposed to serious danger of pollution at the present time. An analysis of the water shows that the color is less than usual, while in other respects it shows no material change from the previous examinations.

In the opinion of the Department, the source is a safe one from which to take an additional supply of water for the town of Ipswich at the present time.

LENOX.

JUNE 9, 1915.

To the Lenox Water Company, Lenox, Mass.

GENTLEMEN: — The Commissioner of Health received from you on May 7, 1915, an application for advice as to the proposed new reservoir to be built just below the present large reservoir of the Lenox Water Company, accompanied by a general plan of the proposed works.

The plan provides for constructing a dam about 250 feet in length

across the brook which forms the outlet of your present reservoir at a point about 350 feet below the dam of the main reservoir. The construction of this dam will create a reservoir having an area of approximately one acre and an available storage capacity to a depth of 8 feet of 1,750,000 gallons. It is estimated that the works will cost about \$12,000.

Information is presented with your application showing measurements of the flow of the brook above and below the Root Reservoirs and as to the quantity of water used by the town as shown by the records of the Venturi meter recently installed on the main leading from Root Reservoir to the distributing reservoir. Observations indicate that the average consumption of water during the greater part of the month of May was about 254,000 gallons, exclusive of a small amount yielded by the watershed of the distributing reservoir.

The Commissioner of Health has caused the location of the proposed reservoir to be examined by the engineer of the Department and has considered the information presented. The additional watershed that will be made tributary to your water supply system by the construction of the proposed reservoir is insignificant and the chief advantage to be obtained from the construction of this reservoir will be the interception of leakage past the dam of the Lower Root Reservoir. There are indications that this leakage is considerable when the reservoir is full or nearly so, and it probably diminishes gradually as the reservoir is drawn down. It is impracticable without actual observations of the flow of the brook with different amounts of water in the Lower Root Reservoir to determine the additional quantity that will be obtained by the construction of the new dam, but an inspection of the locality indicates that the amount of water intercepted may average from 50,000 to 100,000 gallons per day. The amount will vary in different seasons, being less in dry seasons when the reservoir is low and greater in wetter seasons when the water in the Root Reservoir is maintained at higher levels than has been the case in recent years. The construction of this reservoir will not add to the calculated yield of the works as stated in a communication to you from this department under date of May 4, 1914, but it will intercept a considerable amount of water which has hitherto been lost by leakage past the dam, and if the new dam is carefully built and the leakage effectually prevented at the cost estimated in your application, the construction of the dam is advisable.

It is recommended that the bottom of the proposed new reservoir be carefully prepared for the storage of water by the removal of all soil and vegetable matter from the area to be flowed.

By the installation of the Venturi meter on the main pipe leading to your distributing reservoir, it will now be practicable to determine very closely the quantity of water used by the town. It will also be practicable, by means of the fifty meters secured for use on services where the consumption of water is thought to be large, to determine whether excessive quantities of water are used or wasted on the estates to which these meters are applied during the summer season. It is desirable that all of these meters be read at as frequent intervals as practicable during the coming summer, not only to note the total quantity of water drawn but the variations in flow under varying weather conditions. It is advisable also that the gates, blow-offs, etc., recommended in the previous communication be installed as soon as practicable. It is also important that the works for drawing water from Laurel Lake be maintained in condition for use during the coming year, since the rainfall thus far during the present year is much below the average and there is great danger of another shortage of water unless exceptionally heavy rains shall occur within the next few weeks. If the deficiency in rainfall continues, it will be advisable to begin drawing water from Laurel Lake at an earlier time than usual.

LOWELL.

AUG. 24, 1915.

TO MR. JAMES H. CARMICHAEL, *Commissioner of Water Works and Fire Protection,*
Lowell, Mass.

DEAR SIR: — The State Department of Health has considered your request for advice relative to certain proposed connections between the water pipe system of the city of Lowell and that of the Proprietors of the Locks and Canals on the Merrimack River, to be used only at times of serious fires, and has considered the plans and other information presented therewith.

The plans provide for connections at the present time to be located at three points, viz., one at East Merrimack Street near the Concord River between the Prescott Spinning Mill and new mill of the Massachusetts Cotton Mills, one in Jackson Street opposite the Appleton Company's coal shed, and the third at the corner of Race and Hall streets. Memoranda as to the proposed connections and the maintenance thereof are submitted with your application as follows: —

The Insurance Companies, both Mutual and Stock Companies, have expressed a strong desire that there be one or more connections between the water systems for extinguishing of fires belonging to the City and to the Locks &

Canals, to be used especially in case of a breakdown in the mains of the Locks & Canals system during an extensive conflagration.

In providing such connection, the City will no doubt require that it shall be impossible for water to flow from the Locks & Canals pipes into the City pipes, but that water may when desired by the City flow from the City pipes into those of the Locks and Canals pipes.

To accomplish this a connecting pipe, say 12 inches in diameter, should be provided first with two water tight positive gates, one near the City main and one near the Locks & Canals main, to be under lock and key of the City, with no access thereto by any other party.

Between these two gates are to be two check valves as constructed by the Factory Mutual Insurance Companies opening towards the Locks & Canals main and closed towards the City main. Between these two check valves is to be a chamber that may be entered and may at any moment be inspected through glass, having a small drain open to a sewer by which this chamber may be ordinarily kept free from water and any leakage from any of the gates or valves be detected.

In addition there should be adjacent to the positive gates a pressure gauge attached to the City pipe; another attached to the Locks & Canals pipe and still another connecting with the chamber between the check valves, all placed side by side indicating to the City the difference in pressure in the two systems and guiding the City not to allow either of the positive gates to be opened unless the pressure in the City main is ample to prevent any water passing from the Locks & Canals main towards the City main.

This apparatus put in and maintained by the City at the expense of the Locks & Canals would appear to be a complete safeguard to the health of the City and three of them being situated as follows, viz.: one in East Merrimack Street, connecting the City 24 inch main with the Locks & Canals 24 inch main, or one of its 20 inch branches: a second one on Jackson Street near the Hamilton Manufacturing Co.'s counting room connecting the City's 16 inch main with the Locks & Canals' 12 inch main; and a third one on Hall Street connecting the 20 inch City main with the 16 inch Locks & Canals main, — would provide means of saving mill property after the Locks & Canals system had been more or less disabled and preventing a conflagration sweeping across the mill property to the City property beyond.

The Department of Health has caused the question submitted to be considered by its engineer and has examined the plans and information presented. It is desirable that, if practicable with safety to the health of the city, some means should be provided whereby the two pipe systems, those of the city of Lowell and those of the Proprietors of the Locks and Canals, could be available to the fullest practicable extent for use in case of fire in the city of Lowell.

The plan presented appears to this Department to provide a practicable and reasonably safe method by which the pressure in the water

supply system of the Locks and Canals can be supplemented from the pipes of the city of Lowell in case of a draft at the time of a fire greater than the Locks and Canals mains are capable of supplying without serious loss of head. The plan of the proposed connection in East Merrimack Street, which is to be followed in the construction of the other connections, appears to the Department to be a suitable one to adopt. This connection should be constructed in accordance with the specifications of the memoranda quoted above, and for additional safeguard the Department suggests the adoption by your department of a set of rules substantially as follows, to be posted in each connection chamber, in the offices of the Department of Water Works and Fire Protection of the City of Lowell, and in those of the Proprietors of the Locks and Canals on the Merrimack River.

1. The keys of this chamber are to be kept in the possession of a person or persons designated from time to time by the Department of Water Works and Fire Protection of the City of Lowell.

2. This chamber shall be opened only by a person or persons authorized to do so by the Department of Water Works and Fire Protection of the City of Lowell.

3. The condition of the chamber, of the gates and of the check valves, gages, etc., shall be carefully inspected by the Department of Water Works and Fire Protection of the City of Lowell and by the Proprietors of the Locks and Canals upon such dates and at such times as shall be mutually agreed upon but at least once in each calendar year.

4. The date of the last inspection and the names of the persons making the inspection shall be posted in each of the connection chambers and in the offices of the Department of Water Works and Fire Protection of the City of Lowell and of the Proprietors of the Locks and Canals.

5. A written report of each inspection and of the conditions found shall be made, both to the Department of Water Works and Fire Protection of the City of Lowell and to the Proprietors of the Locks and Canals.

6. The maintenance of the connection chamber shall be in charge of the Department of Water Works and Fire Protection of the City of Lowell.

It is also important that the Department of Water Works and Fire Protection keep available at all times a competent person to take charge of the operation of the gates in each chamber, and each person given such charge should be instructed carefully in his duties. The department should also post upon the walls of each chamber full in-

structions as to the observation of the gages and the operation of the gates with reference thereto. These rules should provide that when the use of the connections seems likely to be required the person in charge of each connection chamber shall observe carefully the gages, and when the pressure in the Locks and Canals mains falls below that of the city of Lowell to the extent of a certain fixed number of pounds, both positive gates shall be opened at once and shall be allowed to remain open until the pressure in the Locks and Canals mains rises within a fixed amount of that in the city mains, when at least one of the positive gates should be closed at once. The determination of the number of pounds that the Locks and Canals gage should be allowed to drop below the city gage before opening the connections will depend somewhat upon circumstances and should be fixed by the Department of Water Works and Fire Protection of the City of Lowell. It is probable that a difference of 10 pounds would be a reasonable one; that is, when the pressure in the Locks and Canals mains becomes 10 pounds lower than that in the city mains the positive gates would be opened, and when the pressure in the Locks and Canals mains again rises to within 10 pounds of the pressure in the city mains the positive gates would be closed.

After the emergency has passed, both positive gates should be closed and the water in the check valve chamber discharged to the sewer. It will be essential also that some provision be made for keeping enough water in the trap of the sewer connection to prevent any gases which may be present in the sewer at any time from entering the chamber. If it is deemed impracticable to do this, the sewer connection should be made with a positive gate with a satisfactory arrangement for opening it whenever it becomes necessary to discharge water from the chamber.

In the opinion of the Department, if the works are constructed according to the plans submitted and are maintained in accordance with the suggestions herein contained, danger of contamination of the water of the city through these connections can be avoided.

DEC. 16, 1915.

To Dr. C. E. SIMPSON, *State District Health Officer, Lowell, Mass.*

DEAR SIR: — In response to your request, the State Department of Health has caused an examination to be made of the water supplied at the house at 89 Varnum Avenue to determine the presence of lead, the results of which show that the quantity of lead, both in the sample collected during ordinary use and in the sample collected after

water had been standing in the pipe for a considerable time, was less than the minimum amount known to have caused lead poisoning.

An examination has also been made of the water from a tap at 22 Phillips Street, the results of which show the presence of an excessive quantity of lead, even in ordinary use, while the quantity obtained from a sample that had been standing in the pipe for a considerable time was nearly five times the minimum quantity known to have caused lead poisoning.

The water in both cases is supplied from the works of the city of Lowell and copies of these analyses are appended hereto.

LUNENBURG.

FEB. 2, 1915.

To the Lunenburg Water Company, Lunenburg, Mass., EMERSON W. BAKER, Esq.,
President.

GENTLEMEN: — The State Department of Health received from you on Jan. 16, 1915, the following application requesting approval of a certain source of water supply for the town of Lunenburg under the provisions of chapter 339 of the Acts of the year 1914:

Under the provisions of Acts of the year 1914, chapter 339, the Lunenburg Water Company hereby make application to your Honorable Board for approval of the source of water supply under said Act, by driven and artesian wells, located in Carr's Meadow, so called, in said Lunenburg, upon which test wells have recently been driven and operated.

Investigations for a water supply for Lunenburg have been carried on in various localities in the town, the most favorable conditions being found in the locality known as Carr's Meadow, situated about $\frac{3}{4}$ of a mile south of the center of the main village of Lunenburg. In the latter part of 1914 a test was made in this locality by sinking a tubular well, and samples of water taken from this well indicated that the ground water in the region was probably of good quality for domestic use. Furthermore, the test well yielded water quite freely when pumping with a hand pump and, in view of the conditions, it was determined to make a further and more thorough test for obtaining a water supply for the town in this locality.

For the purpose of this test, nine additional wells were driven in two lines, making an angle of 45 degrees with each other, the length of one line being 95 feet and the other 120 feet, with five wells in each line. In sinking the wells a deep layer of sand and gravel was found extending down to a maximum depth of $22\frac{1}{2}$ feet beneath the surface

and growing coarser toward the bottom. Hardpan is said to have been encountered beneath this gravel layer.

A pumping test was then made by pumping continuously from nine wells for a period of five days between Dec. 31, 1914, and Jan. 5, 1915, and during this test samples were collected daily for analysis and observations were made upon the variations in the height of the ground water in an observation well selected for the purpose. During the test water was pumped at an average rate varying from 151,000 to 184,000 gallons per day, the average rate throughout the test being about 175,000 gallons per day.

The Commissioner of Health has caused the locality to be examined and has considered the information presented relative to the location and surroundings of the wells and the results of tests as to their probable yield and the probable quality of the water to be obtained therefrom.

The results of the chemical analyses of samples collected during this test show that the water is clear, colorless and odorless and in all respects of good quality for domestic use. The test was made near the end of a period of exceptionally dry weather and, judging from the information presented, it is probable that the wells in this location will yield an adequate quantity of water for all the requirements of Lunenburg at the present time and can be extended without serious difficulty and expense so as to be made adequate for a considerably larger population if necessary in the future.

The Department hereby approves the taking of water from the ground in the locality in question as a source of water supply for the Lunenburg Water Company, under the provisions of chapter 339 of the Acts of the year 1914.

MANSFIELD.

MARCH 16, 1915.

To the Board of Health, Mansfield, Mass., Dr. W. H. ALLEN, Chairman.

GENTLEMEN: — In response to your request for an examination of the water supply of the town of Mansfield and advice as to its condition, and also for an examination of certain wells on the estate of Joseph Smith and advice as to their use in connection with the milk supply, the Commissioner of Health has caused the sources indicated to be examined and samples of their waters to be analyzed.

The water supply of Mansfield shows improvement since the town acquired the land for the protection of this source in 1911, and in the condition in which it was found at the time of this examination the

water was practically free from bacteria and of excellent quality in other respects.

An analysis of the water of the well in the field at the rear of the house on the Smith estate shows some evidence of previous pollution, but at the time of the examination the water was being quite thoroughly purified in its passage through the ground before entering the well. The well is exposed to danger of pollution from the surface of the ground and in the manner of drawing the water, and the number of bacteria present in the water at the time of this examination was large. It is probable that if the curb of this well were raised above the level of the surrounding ground and securely covered so as to prevent the entrance of surface water or of water falling from the pump upon the platform, the source would be a safe one from which to take water for domestic purposes.

The water of the well to the west of the house has not yet been examined chemically, but the number of bacteria present was high, due probably to the method of drawing the water from the well. It is likely that if the curb about this well also was raised above the level of the ground and the well was securely covered so as to prevent the entrance of surface water, it would supply water of good quality. It would be essential, however, to provide a different method of drawing the water from that in use at present, by which no doubt the well may receive considerable bacterial pollution.

If it is decided to improve the conditions about these wells, a further examination of their waters will be made by this Department, if so requested, to determine the condition of the water after danger of surface pollution has been eliminated.

MARBLEHEAD.

TO HERBERT J. HALL, M.D., *Marblehead, Mass.*

JAN. 18, 1915.

DEAR SIR: — In response to your request for advice as to the probable effect upon the water supply of Marblehead of the burying of cattle, some of which were afflicted with the foot and mouth disease, at a point in Swampscott not far from the boundary of the town of Marblehead, the Commissioner of Health has caused the locality to be examined and has considered the information presented.

It appears that on Dec. 5, 1914, during an epidemic of foot and mouth disease, about thirty-nine cows were buried at a point about 2200 feet southwest of well No. 2, so called, one of the principal sources of water supply of the town of Marblehead, quicklime being used in the burial of the cattle.

The Marblehead water supply, coming chiefly from well No. 2, is a ground water source derived from the rainfall which percolates into the ground in a large area about the well and filters slowly through the ground about the well. It is impossible to say definitely whether the ground water from the neighborhood of the point where the cattle are buried filters toward the well, but in case this happens, it is likely that the water would be thoroughly purified before reaching the well, and there is no likelihood whatever that any injury would result to the quality of the water which would make it injurious to the health of those who use it for drinking. Moreover, before being supplied for drinking, this water is again filtered through the well-designed filter plant constructed at the pumping station.

Under the circumstances, there need be no apprehension, in the opinion of this Department, that the burial of the cattle at the point in question will have an injurious effect upon the health of those using the water supplied to the town of Marblehead from the works at Loring Avenue.

MARION.

SEPT. 15, 1915.

*To the Board of Water Commissioners, Marion, Mass., Mr. GEORGE M. DELANO,
Chairman.*

GENTLEMEN: — In response to your request of Aug. 26, 1915, for advice as to the use of water from the new wells in the northerly part of the town, the State Department of Health has caused the wells and their surroundings to be examined and further samples of their waters to be analyzed.

The results of the analyses show that the quality of the water remains practically the same as during a pumping test of last year, and we are unable to give you at the present time any more definite advice concerning the matter than was given under date of Nov. 19, 1914, the essential points of which were as follows:

. . . The results of the analyses of samples of water collected during the test indicate very clearly that part at least of the water entering these wells has at some time been badly polluted. The chlorine, residue and hardness were more than twice as great as in the water of your present sources of supply, and the nitrates were more than seven times as great.

In the condition in which the water was found during the test, however, it was probably safe for drinking. There is, however, an objection to the use of such a water for the supply of the town for the reason that, when water is drawn in such quantities as will be necessary for all requirements in the drier part of the year, the quality is likely to change, and it may deteriorate to such an extent as would make it unsafe for drinking. . . .

Under the circumstances, so long as the water remains about as found at the time of the recent test, there appears to be no serious objection to its use, but as the quality may change with pumping, it is desirable that analyses be made at frequent intervals so that if deterioration should occur to such an extent as to render the water unsafe for drinking its use could be discontinued.

It appears to be practicable to obtain a very considerable quantity of water at this location but, in view of its quality and danger of deterioration if large quantities are drawn, it is advisable that this source be maintained and operated strictly as an emergency supply and your main supply be drawn from the original source to the full extent that that source will yield.

MONSON (STATE HOSPITAL).

AUG. 11, 1915.

To the State Board of Insanity, Mr. CHARLES E. WARD, Treasurer, State House, Boston, Mass.

GENTLEMEN: — In response to your request for an examination of the water of certain test wells recently driven at the Monson State Hospital, and advice as to its quality, the State Department of Health has caused the wells and their surroundings to be examined and samples of their waters to be analyzed.

The results of the analyses show that the waters taken from test wells Nos. 1, 2, 4, and 5 are soft and in their present condition of good quality for all domestic purposes. The information supplied as to the character of the soil in which the wells were sunk shows that it is coarse and porous to a considerable depth and water could be pumped very freely from all of the wells with a hand pump. These indications are favorable to obtaining a considerable quantity of water from the ground in this region by means of tubular wells. While the quality is good at the present time, the wells are located quite near the Quaboag River which receives considerable pollution, and also at no great distance from the sewage disposal area of the hospital. In view of these conditions, the Department is of the opinion that, if water from this source is to be used for the purposes of a domestic water supply in the hospital, a test of the probable yield and quality of the water obtained from these wells be made by pumping continuously from a group of five or six wells in this region for a period of at least a week and at a rate of as much as 100,000 gallons per day. Samples of water should be collected daily during this test to determine whether any deterioration takes place. If you decide to make a further in-

vestigation the Department will assist you by making the necessary analyses of water and will give you further advice as to the use of water from these wells when the results of further tests are available.

Nov. 10, 1915.

To the State Board of Insanity, State House, Boston, Mass.

GENTLEMEN: — In response to your application of Oct. 21, 1915, for advice as to taking water for the supply of the Monson State Hospital from the ground northeast of the main building and lying between the railroad and the Quaboag River just below the mouth of Chicopee Brook, the State Department of Health has caused the test wells in the location indicated to be examined and has considered the results of a test made by pumping from the wells continuously for a period of several days between October 1 and October 8.

During this test the quantity of water drawn from the wells amounted to an average of somewhat over 200,000 gallons per day. Observations of the height of water in test wells in the neighborhood of the group of wells from which water was being drawn show that the height of the ground water fluctuated apparently with the height of water in the Quaboag River, near which the wells are located, one of the wells being within about 57 feet of the river and the others at greater distances up to about 200 feet from the river.

The results of the test indicate that a quantity of water adequate for the present requirements of the institution can be obtained from the ground in the region in which this test was made.

The results of analyses of samples of water collected from time to time during the test show considerable variation but indicate on the whole that water of good quality for domestic use can be obtained from the ground in this region. If a large quantity of water were drawn from the ground in this region a portion of it would be likely to come from the Quaboag River by filtration through the ground, and it is impracticable to tell from this limited test to what extent the well water is likely to be affected in quality by water filtering from the river toward the wells, especially in the drier portion of the year. So far as can be judged, however, from the tests thus far made, any water which finds its way to the wells from the river is likely to be thoroughly purified so long as the quantity of water drawn does not greatly exceed the amount of water required for the present supply of the institution. If much larger quantities of water should be drawn from the ground in the neighborhood of these wells, it is possible that the quality of the water would be unfavorably affected by filtration from

the river, and there is a further danger that the ground water in this region under those circumstances might be affected by effluent from the filter beds located several hundred feet west of the wells.

The quantity of water required by the institution at the present time, however, is not large, and, in the opinion of the Department, the source is an appropriate one from which to take water for the use of this institution at the present time. It is recommended that analyses of the water be made from time to time in order that should serious deterioration occur the use of the wells can be discontinued.

MONTAGUE (TURNERS FALLS).

FEB. 3, 1915.

To the Board of Water Commissioners of the Turners Falls Fire District, Turners Falls, Mass.

GENTLEMEN:— In response to your request, an examination has been made of the water of Lake Pleasant and of a tap in Turners Falls to determine the condition of the water and the cause of the objectionable taste and odor by which the water supplied to the consumers is at present affected.

The results of the examination show that the cause of the trouble is the presence of large numbers of the organism *Dinobryon*, one of the *Infusoria*, which has been known when present in such numbers as are found in this case to cause objectionable tastes and odors in the waters of other ponds and reservoirs.

There is no practicable way of preventing the appearance and growth of such organisms in Lake Pleasant, and their effects can best be removed by filtration of the water. Such abundant growths as this, however, are uncommon in the water of this lake which is usually of good quality for domestic use and, even when affected by these organisms, there is no reason to believe that the water when used for drinking is injurious to health. It will be best to avoid opening hydrants or drawing any larger quantity of water through the pipe system than necessary while the organisms remain in the water of the lake, but as soon as the numbers begin to diminish it will be advisable to flush the pipes thoroughly.

It is probable that, if the water near the intake were examined daily, any improvement in its quality could be noted, but this Department will, if you desire, have samples examined microscopically once or twice a week, if you will collect the samples, and will advise you promptly as to the numbers of organisms found on each examination. It is impossible to advise you as to how long these objectionable con-

ditions will continue. Usually they disappear after a period of three or four weeks, but they may continue for a considerably longer time while ice remains upon the pond.

MAY 6, 1915.

To the Board of Water Commissioners, Turners Falls, Mass.

GENTLEMEN:—The Commissioner of Health has considered your letter of April 29, 1915, and enclosures, and also your communication of April 26, 1915, relating to seining fish from Lake Pleasant, the source of water supply of the Turners Falls Fire District and adjacent communities.

The proposed method of seining the lake is not described but is presumably to be carried out with the use of nets operated by men in boats and on the shore. The nets and other equipment necessary for the work must be hauled to the lake and the work must be done upon its shores and waters.

The operation necessarily involves considerable disturbance of the waters of the lake and the danger of introducing infectious matter, and under the circumstances the removal of the fish from the lake as proposed is not recommended.

NEW BEDFORD.

OCT. 21, 1915.

To Mr. R. C. P. COGGESHALL, Superintendent Water Department, New Bedford, Mass.

DEAR SIR:—In response to your request for an examination of the water supply of New Bedford, concerning which a recent communication to your department states that the chemical analyses made by this Department indicate considerable pollution, the State Department of Health has caused your sources of supply to be examined by its engineer and has considered the results of analyses of water as shown by the records in this Department and by samples collected recently from various parts of the system.

The water supply of New Bedford is taken from Little Quittacas Pond, which is supplemented with water flowing from Great Quittacas Pond, the water of these ponds being derived from an aggregate watershed area of 12.85 square miles, of which the area of the ponds comprises 2.35 square miles.

Analyses of the water of Great Quittacas Pond, which is the larger of the sources, show that there has been little variation in the quality of this source for many years. The amount of chlorine in the water is approximately normal for the region, and the average amount pres-

ent in the samples of water examined in 1914, for example, was a little less than was present in the samples examined in the year 1897, indicating that there has been no increase in the pollution of the water at least within a period of seventeen years. In other respects there is no evidence of deterioration within the long period covered by the examinations of this source.

The water of Little Quittacas Pond also, which has normally a low color, shows no material change for many years, except a slight increase in color due to an increasing admixture of the water of Great Quittacas Pond, which has a higher color.

A careful examination of the entire area of the watersheds of these ponds shows no evidence that pollution is entering the ponds or their tributaries at any point throughout the extent of their watersheds. At the extreme upper end of Black Brook, a tributary of Great Quittacas Pond, there are two small villages, but no pollution was found to be entering the streams from any of these buildings, and very few of them are located in the neighborhood of the streams.

Many years ago the city wisely purchased the shores of these ponds throughout their extent and thus secured immunity from danger of pollution of the water by settlements in the neighborhood of the ponds. Their shores are clean and free from débris, and the works in general are in excellent condition from a sanitary point of view. The only dwellings in the country about the ponds are located remote from their shores in a region composed of a porous gravelly soil, from which there is no danger that serious pollution can find its way into the ponds.

Finally, bacterial examinations of the water at different points throughout the system during the present year show that the number of bacteria is very low and that the objectionable kinds are absent.

The results of these investigations show that the water supply of New Bedford as taken from these ponds is entirely satisfactory from a sanitary point of view and that no treatment of the water, whether by chlorine or any other process, is necessary.

NORTH ADAMS.

JUNE 24, 1915.

To Mr. JOHN MARTIN, *Commissioner of Public Works, North Adams, Mass.*

DEAR SIR: — The State Department of Health has considered your request for advice as to the probable effect upon the quality of the water of the Notch Brook Reservoir of the continued use of fertilizers upon certain lands adjacent to that reservoir in the city of North

Adams, a plan of which was submitted with your application, and has caused the locality to be examined by the engineer of the Department.

The watershed of the Notch Brook Reservoir is practically uninhabited and the water drawn from it is naturally of good quality for domestic use. It is affected at times, in common with most ponds and reservoirs, by growths of microscopic organisms which, however, while they are not known to be injurious to health, impart to the water at times a disagreeable taste and odor.

The use of fertilizers upon the lands in question, which are located on the westerly side of the reservoir and slope quite steeply down to the water, undoubtedly results in the introduction into the reservoir of substances which have a tendency to foster organic growths. The watershed of the reservoir is now practically uninhabited and the city of North Adams has secured control of all of the areas from which objectionable drainage can enter the reservoir, with the exception of the lands in question.

In view of the circumstances, the Department recommends that these lands be acquired by the city at the earliest practicable time and that the use of fertilizers thereon be thereafter prevented.

JUNE 24, 1915.

TO MR. JOHN MARTIN, *Commissioner of Public Works, North Adams, Mass.*

DEAR SIR: — The State Department of Health has considered your request for an examination of your water supply system, especially the Beaman Reservoir, preliminary to putting this reservoir into service for the water supply of the city, and in response to this request has caused the water works system of North Adams to be examined by the engineer of the Department and samples of the water to be analyzed.

The results of analyses of the water of the Notch Brook Reservoir show that no material change has taken place in the quality of the water of this source for several years.

The new Beaman Reservoir was partially filled and completely drained out several times between January and April and filled to overflowing in May, since which time it has remained full. Several analyses of the water have been made by this Department, including bacterial analyses of samples taken at the time of the recent inspection. The results show that the quality of the water has improved rapidly since the reservoir was first filled and that in its present condition it is of good quality for domestic use. A careful examination

of the surroundings of the reservoir shows that all sources of pollution have been removed and that all objectionable buildings have been either removed from the watershed or were in process of removal at the time of this inspection.

The shores of this reservoir and its surroundings are in excellent condition and, in the opinion of this Department, the waters of the Beaman Reservoir may now be used at any time for the supply of the city.

NORTHBRIDGE (ROCKDALE).

Nov. 11, 1915.

To the Paul Whitin Manufacturing Company, Northbridge, Mass., Mr. PAUL WHITIN, Manager.

GENTLEMEN: — In connection with an investigation as to the occurrence of a number of cases of typhoid fever in the village of Rockdale, the State Department of Health has caused the sources of water supply in use in the village to be examined and samples of their waters to be analyzed.

It appears that the original supply was drawn from a reservoir or filter gallery located in a small valley west of the village and at a sufficient elevation to provide a small supply of water by gravity. Subsequently, a number of tubular wells were driven close to the westerly side of the New York, New Haven and Hartford Railroad and about 225 feet south of the most southerly dwelling house on Railroad Street in the village, and water is pumped from these wells to the village and to the reservoir used in connection with the filter gallery.

At the time the investigations were made previous to introducing the driven well supply, a test of the ground water in this region was made by pumping from a test well in this locality for several days. During the test analyses of the water indicated that some of the water entering the well had been polluted but subsequently purified in its passage through the ground, and in the condition in which it was found at that time the water was of good quality for domestic purposes. It was suggested, however, that if a large quantity of water were drawn from the ground in this locality the quality might deteriorate. The village has grown rapidly since that time, and recent examinations show that the water of these wells, which are located rather nearer to dwelling houses than the original test well, has greatly deteriorated, though there is no indication that the water has yet reached such a condition as to be injurious to health.

In view of the marked deterioration in the quality of this water, however, these wells cannot be considered as safe sources from which

to take water for domestic use since the quality of the water would probably continue to deteriorate in the future and eventually become injurious.

It appears that, while the tubular wells and filter gallery furnish the domestic water supply for the village, the pressure from these sources is not regarded as sufficient for fire purposes, and at times of fire water is admitted to the distribution pipes under pressure from the fire protection system of the mill in which Blackstone River water is used and also from a reservoir filled with Blackstone River water located on an elevation northeast of the village and much higher than that of the domestic supply reservoir. There are apparently two connections between the fire supply and the town supply and it appears that when a fire occurs, as happened on September 27th last, the water from the Blackstone River supply is pumped into the village mains until the fire is extinguished. It is furthermore found that it is the practice to notify the inhabitants by a signal as to the opening of the gate from the fire supply into the village distribution mains and that the inhabitants are instructed not to use the water supply during the progress of the fire. On the date mentioned, after the connection between the systems was closed, the village mains were thoroughly flushed for the removal of the water from the Blackstone River, which is said to be the usual practice. When the water from the mains was analyzed about one month after the occurrence of the fire, there were no indications of the presence of objectionable bacteria in the village mains. Nevertheless, the practice of introducing Blackstone River water into the town pipes is a very objectionable one and should be discontinued at the earliest possible time.

The Department recommends that an adequate supply of water from some source of known purity be provided for this village under pressure adequate for all purposes at the earliest practicable time. As soon as such a supply is available the connections between the fire protection supply in the mill, which draws water from the Blackstone River, and the pipes of the village system, through which water is supplied for domestic use, should be completely removed so that it will not be possible for Blackstone River water to enter the distribution pipes of the village under any circumstances. Until a new supply under adequate pressure has been provided, if it is necessary to introduce water from the Blackstone River to the mains in case of fire, the precautions which you have previously taken should be very closely observed, and the inhabitants of the village should furthermore be notified to boil all water used for drinking.

The Department will assist you in investigations for a new supply

by making the necessary analyses of water and will give you further advice in the matter, if you so request, when the results of investigations are available. The present is a favorable time for making such investigations and, if the work is begun without delay, it may be practicable to provide a supply of good water under suitable pressure for the requirements of the village within a few weeks.

NORTHFIELD (NORTHFIELD SCHOOLS).

JULY 15, 1915.

TO MR. AMBERT G. MOODY, Clerk, *The Northfield Schools, East Northfield, Mass.*

DEAR SIR:— The State Department of Health has considered your application for advice as to a proposed filter to be located in Bonar Glen on Louisiana Brook and has caused the proposed location to be examined and samples of the water to be analyzed.

The plan in general provides for purifying the water of Louisiana Brook, and in case of necessity water from Perchog Brook, and using it for the domestic supply of the Northfield Schools. The plan shows a filter 80 feet by 35 feet, which is to contain a depth of $4\frac{1}{2}$ feet of filtering material over 6 inches of graded gravel and underdrains. From the filter the water will flow to a pump well 15 feet by 50 feet by 10 feet in depth having a capacity of 56,000 gallons, whence it will be pumped for the supply of the schools.

Of the samples of sand submitted by your engineer, it is recommended that the sand obtained from the sand bank near the filter, which furnishes material having an effective size of about .22 of a millimeter, be used in the construction of the filter. The total filtering area will amount to about $\frac{1}{15}$ of an acre and, if the quantity of water used amounts to 125,000 gallons daily as estimated by your engineer, the rate of filtration would be a little less than 2,000,000 gallons in 24 hours.

In the opinion of the Department the filter, if constructed as proposed and properly operated, will provide for the efficient purification of the water of the brooks which you propose to use. It is of the greatest importance that during the time that the water of these brooks, or either of them, is being used special care shall be taken to prevent polluting matters from entering these streams. It will also be advisable, before the filter is put into use in each year, to operate the filter and waste the water into the brook for several days and to have the filtered water analyzed before the use of the filter is begun.

By observing the suggestions herein contained, it is probable that the filtered water from these streams can safely be used as an auxiliary

water supply for the schools. The use of the filtered water from the brooks should, however, be regarded as an emergency water supply, and efforts should be continued to secure a supply from some unpolluted source by gravity, if practicable, and the filter kept thereafter for use only in emergencies.

OXFORD (TOWN FARM).

JUNE 4, 1915.

To the Board of Health, Oxford, Mass., Dr. ROBERT S. FLETCHER, Chairman.

GENTLEMEN: — In response to your request of May 11, 1915, for an examination of the drinking water used at the Oxford Town Farm and advice as to its quality, the Commissioner of Health has caused the well and its surroundings to be examined and a sample of the water to be analyzed.

The results of the analysis show that the water of the well is naturally of good quality for domestic purposes, and the well is not exposed to danger of pollution by sewage. It appears, however, that the water is supplied through lead pipes and a determination of the amount of lead in the water as drawn from the pipe shows that it contains a quantity of lead much greater than the minimum amount that has been known to cause lead poisoning. Under the circumstances, the use of this water as drawn through lead pipe is probably injurious to the health of those to whom it may be supplied for drinking.

The Department recommends that the lead pipe through which this water is conveyed be wholly removed and a pipe of some suitable material which will not be attacked by the water, or if attacked will not cause injury to health, be substituted therefor. A pipe of block tin or of iron lined with tin or with cement could be used with safety with this water, and it is recommended that a pipe of one of these kinds be substituted at the earliest practicable time for the lead pipe now used. In the meantime and until the lead pipe is removed, it is recommended that a supply of drinking water be provided from some suitable source not affected by lead pipe.

The cause of the odor complained of in this water has not been ascertained, but there is no reason to believe that the water would be injurious to health if drawn through a proper pipe, and a change in the pipe may result in the removal of the odor.

It would be well in changing the pipe to provide for the aeration of the water before it enters the pipe, if it is practicable to do so.

PALMER (THREE RIVERS).

DEC. 22, 1915.

To the Board of Health, Palmer, Mass., Mr. W. C. HITCHCOCK, Clerk.

GENTLEMEN: — The State Department of Health has considered your application for advice as to the quality of the water of a well near the mill pond in Three Rivers and has caused the well and its surroundings to be examined and a sample of the water to be analyzed.

The results of the examination show that the well is sunk in gravel about 30 feet from the edge of the river and that there are no buildings within a long distance of the well. The only possible source of pollution is the disposal of privy waste upon a garden about 100 feet from the well. The well was not in use at the time of the examination, and the results of an analysis of the water show that it contains rather more organic matter than is found in good well waters. It is probable, however, that, if the disposal of privy waste in the neighborhood of the well were discontinued, the water of this source could be used with safety for drinking. It is recommended, however, that, in case a large quantity of water is to be drawn from the well for that purpose, another examination be made while the well is in use to determine the quality of the water under those conditions.

An examination has also been made at your request of the water of the deep well in the lumber yard of the Palmer Mill at Three Rivers. This well, as you were advised on July 14 of last year, was found at that time to be very badly polluted, and the Department recommended that its further use be discontinued. A recent analysis shows that the water contains more organic matter than at the time of the previous examination, and the use of the water of this well for drinking or other domestic purposes cannot be recommended.

As to the water supplied from springs for use in the Hastings tenements at Three Rivers, you have already been advised that these springs cannot be regarded as safe sources of water supply, and it was recommended by this Department in July, 1914, that their further use should be discontinued. If another supply has been provided in these tenements from some other source than those thus far examined, the Department will, upon request, cause an examination of the supply to be made and advise you concerning it.

PEABODY.

JAN. 15, 1915.

To the Commission of Public Works, Peabody, Mass.

GENTLEMEN: — The State Department of Health received from you on Jan. 11, 1915, the following petition for its advice and approval, under the provisions of chapter 698 of the Acts of the year 1913, of the taking of certain lands for the protection of the purity of the water of Spring Pond:

Pursuant to a vote of the Commission of Public Works of the Town of Peabody, at a meeting held Jan. 7, 1915, I write in accordance with the provisions of chapter 698 of the Acts of 1913, to obtain advice and approval of the taking or acquisition of the land and property in the Town of Peabody shown upon a plan by George A. Barnaby, Engineer, dated Oct., 1913, a copy of which plan is on file in your office, for the purpose of protecting the water supply of the Town.

The lands which it is proposed to acquire are located in the Overlea District, so called, between Spring Pond Road and the Peabody-Lynn town line in the town of Peabody, and as their acquisition by the town appears to be necessary for the proper protection of the purity of the water of Spring Pond, the Public Health Council on Jan. 12, 1915, approved the taking of these lands which are shown upon a plan filed in this office on Jan. 4, 1915, entitled "Plan of Spring Pond Watershed showing Houses Included and Town's Property Westerly Side of Pond. Scale 1 In.=100 Ft. October 1913. George A. Barnaby, Engineer", and in more detail upon a plan submitted on Dec. 18, 1914, entitled "Tracing from A Plan of House Lots at Overlea. Surveyed By I. K. Harris. Scale 1 In.=50 Ft. March 1914."

APRIL 6, 1915.

To Mr. JOHN BOYLE, Chairman, Commission of Public Works, Peabody, Mass.

DEAR SIR: — Your letter to the State Department of Health received March 31, 1915, requesting advice as to the purchase of land whereon are located the driven wells in the Cedar Pond valley, an answer to which is desired before the town meeting on April 7th, has been referred to me.

While the time available is too limited to make it practicable for the Department to make an investigation sufficient to advise you very definitely in this matter, the questions are much the same as those submitted to this Department last year with regard to the water supply of Peabody.

It appears from the report of your Board for 1914 that pumps having a capacity of 3,000,000 gallons in 24 hours have been installed at

the wells and that between May 1st and December 5th last, a period of about 7 months, an effort was made to pump all of the water possible from the tubular wells. The result, as stated in this report, is that the total quantity pumped in this period was about 94 million gallons, or an average of about 430,000 gallons per day. If in a very dry year like 1914 it is impracticable to obtain more than 430,000 gallons per day between May 1st and December 5th, it will probably not be practicable to obtain an average amount throughout a very dry year that will exceed double this quantity, and, in fact, the daily yield for such a year may be considerably less than double the average daily yield of the drier part of 1914.

The information available indicates on the whole that the addition of the tubular wells to the water supply of Peabody would not increase the supply sufficiently to meet present needs without still continuing to draw upon Cedar Pond.

The quantity of iron in this water during the year 1914 ranged from about .2300 parts in 100,000 in January to .3800 parts in 100,000 in September. The amount fell slightly to .3000 parts in February, 1915, and rose to .3800 parts in March, 1915. The quantity of iron in the water of Suntaug Lake was .0075 parts in 1912, .0080 parts in 1913, and .0110 parts in 1914. In Spring Pond the average quantity of iron present in 1912 was .0248 parts in 100,000, in 1913 it was .0300 and in 1914 .0325 parts in 100,000. A sample from this pond collected in January, 1915, showed .0420 parts in 100,000, and one collected in March, 1915, showed .0450 parts in 100,000.

It will be seen that the quantity of iron in the water of the wells is increasing, as you were advised in my previous letter would probably be the case, and you will also note that the average quantity of iron present in the water of the ponds is also constantly increasing.

It appears from the conclusions of your Board that the quantity of iron in the water has become so great as to make it objectionable in coloring skins in the Peabody factories. The quantity has probably also become great enough to begin to cause trouble in other ways, and it is obvious that the use of the well water can not be continued without filtration.

It is impracticable to determine how much the cost of filtering the well water would be without an engineering study to serve as a basis for estimates. In any case, should the town decide to take the water of the wells, it would still be necessary to provide at once a further additional supply beyond the quantity which the wells and the present sources will yield, in order to provide adequately for the present needs of Peabody in a very dry year.

It is not advisable under the circumstances to adopt the tubular wells as a permanent supply at the present time. It is of the greatest importance that the town shall secure as soon as practicable an adequate supply for present needs and probable future requirements, in order to avoid danger of injuring the interests of the town by neglect to provide sufficient water of satisfactory quality for all proper domestic and manufacturing purposes.

When a definite plan has been selected, it can then be determined whether the tubular wells should properly form a part of such a supply and, if so, how the water should be treated in order that it may be made fit for all the uses of the town. Until this question is studied thoroughly it will be impracticable for this Department to advise you whether or not the wells can reasonably be utilized as a part of the permanent sources of water supply of the town of Peabody.

APRIL 15, 1915.

To the Commission of Public Works, Peabody, Mass.

GENTLEMEN: — The State Department of Health received from you on March 24, 1915, the following petition for its consent to and approval of the purchase or taking of certain lands in the cities of Lynn and Salem for the purpose of protecting and preserving the purity of the water of Spring Pond, one of the principal sources of water supply of the town of Peabody: —

Pursuant to a vote of the Commission of Public Works, at a meeting held Jan. 28th, 1915, I write in accordance with the provisions of chapter 499 of the Acts of 1908, to obtain advice and approval of the taking or acquisition of the land and property in the Cities of Lynn and Salem shown upon plans by George A. Barnaby, Engineer, dated October, 1913, and March, 1914, . . . for the purpose of protecting the water supply of the Town. . . .

In response to this petition a public hearing, required by chapter 499 of the Acts of the year 1908, was held in Room 143, State House, Boston, on Tuesday, April 13, 1915, notice of said hearing having been given by publication in newspapers circulating in the cities of Lynn and Salem and the town of Peabody.

After the hearing, at which no one appeared to oppose the taking of the lands in question by said town of Peabody, the Public Health Council upon consideration voted to consent to and approve of the purchase or taking by the town of Peabody of the lands in question which are in two parcels and are shown upon two plans filed in this office on March 30, 1915, one of which is entitled "Plan of Spring

Pond Watershed showing houses included and Town's Property. West-
erly Side of Pond. Scale 1 in.—100 ft. October, 1913. George A.
Barnaby, Engineer," and the other entitled "Plan showing Parcels
A-B-C purchased by Town in 1909 also additional Watershed Line
near Fay Estate. Scale 1 inch=100 feet. March, 1914. George A.
Barnaby, Engineer".

To the Commission of Public Works, Peabody, Mass.

OCT. 21, 1915.

GENTLEMEN: — The State Department of Health received from you
on Oct. 1, 1915, an application for its advice as to the taking and use
of Cedar Pond as a source of water supply for the town of Peabody,
and in response to this application has considered the information
available as a result of examinations of this proposed source of water
supply and has examined the results of analyses of its waters.

Cedar Pond has apparently an area of about 12 acres, according to
surveys by your engineers, and a storage capacity of about 5 million
gallons. Its drainage area, as measured from the State map, is about
500 acres, and this area contains a considerable number of dwelling
houses, though most of them are located remote from the pond.

Analyses of the water show that it is highly colored and contains
a considerable quantity of organic matter and is often affected by a
noticeable taste and odor. The pond is not a desirable source from
which to take water for drinking, though the water would not be ob-
jectionable if discharged into Spring Pond and thus given the benefit
of long storage before it is used by the town. The source has in fact
been used by the town in this way in past years as an emergency
source at a time when the quantity of water available for the supply
of the town had become seriously reduced. The addition of this
source permanently, however, to the water supply of Peabody would
add comparatively little to the yield of your present sources of water
supply and would not postpone for more than a limited period the
time within which an additional supply will have to be provided to
meet the requirements of the town in a series of dry years. Further-
more, the taking of these waters would decrease the amount of water
available for riparian owners who use the water for manufacturing
along the brook below the outlet of the pond, and the cost of damages
would probably be large in proportion to the quantity of water that
the town would add to the available yield of its sources by the taking
of this water.

Under the circumstances, it is not advisable, in the opinion of this
Department, for the town of Peabody to take Cedar Pond as a per-
manent source of water supply for the town.

PROVINCETOWN (WELLS).

APRIL 8, 1915.

TO MR. J. A. COOK, *Chairman, Board of Health, Provincetown, Mass.*

DEAR SIR: — In response to your request of March 24, 1915, for an examination of a sample of water from a certain well in Provincetown, which is believed to be the source of infection of a case of typhoid fever, the Commissioner of Health has caused the well indicated to be examined and a sample of the water to be analyzed.

The well in question is located at 135 Commercial Street, and consists of a pipe driven into the ground in the cellar of the house. There are numerous sources of pollution in the immediate neighborhood of the well, and the results of the analysis show that the water is grossly polluted and unfit for domestic use, and it is recommended that the further use of the water of this well be prevented at once.

An examination was also made of the well on Kiley Street in a house in which a case of typhoid had recently occurred. It was impracticable to obtain a sample of water from this well, but its location, — directly under the sink in the kitchen and only about six feet from the discharge pipe from the sink, — indicates that it is probably unsafe for domestic use. The public water supply of the town is available to this place and should be supplied to this dwelling, and the further use of the water of this well prevented.

ROWLEY (WELLS).

FEB. 4, 1915.

TO MR. JOSEPH A. DODGE *Edgebrook Farm, Rowley, Mass.*

DEAR SIR: — In response to your request of Jan. 4, 1915, for an examination of the water of a well at your house in Rowley in which a case of typhoid fever has occurred, the Commissioner of Health has caused the well and its surroundings to be examined and a sample of the water to be analyzed.

The results of the analysis show that the water contains a much greater quantity of organic matter and much higher numbers of bacteria than are found in good well waters. There are sources of pollution at no great distance from the well and, considering the circumstances, the source cannot be considered a safe one from which to take water for drinking, and it is recommended that its further use for that purpose be discontinued.

FEB. 12, 1915.

To the Board of Selectmen and Board of Health, Rowley, Mass.

GENTLEMEN: — Upon notification by you in the latter part of last year of the existence of certain cases of typhoid fever in Rowley, an investigation was made to determine, if practicable, the probable source of the disease.

It was found that, while in one or two cases the disease may have been contracted out of town, the infection for the most part was probably caused by conditions existing in the village. A general examination was then made of the sanitary conditions in the town, and especially in the main village, and in the course of this investigation the sources of water supply and methods of sewage disposal have received careful consideration.

The study of the occurrence of typhoid fever in the town of Rowley shows that this disease has been unusually prevalent there over a period of many years, cases of the disease having occurred repeatedly, usually with intervals of several months and sometimes of several years, in certain portions of the village. The general examinations show that the sanitary conditions of the town are in most respects satisfactory, but the examination of the well waters at houses where cases of typhoid fever have occurred has shown that in all cases these waters are grossly polluted.

In view of the conditions found at these places, the examination was extended generally throughout the main village, and samples of water were collected from sixty-three wells in all parts of the village. The results of these examinations show that the waters of practically all of the wells used as sources of water supply are polluted, and most of them grossly polluted, evidently by sewage from vaults and cess-pools used for the disposal of the sewage of the various dwelling houses.

In view of these conditions, the Commissioner of Health is of the opinion that the wells from which the inhabitants of the village obtain their supplies are unsafe sources from which to take water for drinking and, considering the excessive prevalence of typhoid fever in this town for a period of many years, it is recommended that the town take such action as is necessary to provide a public water supply from a source of known purity at the earliest practicable time. Until such a supply is available, the Commissioner recommends that you notify the inhabitants of the village of the danger involved in the further use of the well waters in this village for drinking and to boil all water taken from these wells before using it for that purpose.

Nov. 9, 1915.

To the Board of Selectmen, Rowley, Mass., Mr. J. N. DUMMER, Secretary.

GENTLEMEN: — In accordance with your request of Oct. 19, 1915, for an examination of the water of a well owned by Mrs. Stephen Pierce and located on Jellison Road, Rowley, the State Department of Health has caused the well and its surroundings to be examined and a sample of the water to be analyzed.

It appears that the well is of the ordinary dug type lined with brick and is used as a source of water supply by two families in neighboring houses.

The results of the analysis show that the water of this well is very badly polluted and unfit for domestic use.

The Department recommends that the further use of the water of this well for domestic purposes be discontinued.

On Feb. 12, 1915, this Department sent a communication to your board relative to the serious pollution of the ground water throughout the main portion of the village of Rowley and its relation to the continued prevalence of typhoid fever in the town over many years, recommending that the question of a public water supply for the thickly settled portion of the town be taken up at once for consideration. The Department requests information as to what action the town has taken toward the prevention of the great amount of unnecessary sickness in the town of Rowley and the efficient protection of the public health there by the introduction of a supply of pure water.

SALEM.

JAN. 12, 1915.

To the Salem and Beverly Water Supply Board, Salem, Mass., Hon. NATHAN MATTHEWS, Chairman.

GENTLEMEN: — The State Department of Health received from you on Dec. 10, 1914, the following application for the advice and approval of the Department, under the provisions of chapter 700 of the Acts of the year 1913, of a plan for a canal and conduit designed as a part of a works to divert water from the Ipswich River into Wenham Lake:

The Salem and Beverly Water Supply Board organized under chapter 700 of the Acts of 1913, hereby applies to your board for its approval of the plans prepared by Messrs. Hazen & Whipple for the diversion of the Ipswich River water to Wenham Lake by means of a canal, pumping plant and conduit, as more particularly appears in a report signed by Mr. Hazen under date of Nov. 27, 1914, enclosed herewith, and four several plans dated Nov. 17, 1914, also herewith submitted. If the department wishes the specifications which accompanied Mr. Hazen's plans a copy will be sent.

The application was accompanied by a plan showing the location of the proposed works. Upon this plan is shown the line of a proposed canal extending from a point near the right or eastern bank of the Ipswich River about 4,200 feet below the point where it is crossed by the Newburyport turnpike to a proposed pumping station to be located about 700 feet northwest of Cherry Street; thence a force main to discharge into a conduit which extends to low ground about 700 feet southeast of Cherry Street whence an open channel is shown leading to an outlet on the southerly side of Cedar Street at the edge of a shallow basin connecting with Wenham Lake.

The Commissioner of Health has examined the locality and the Public Health Council has considered the application and plans presented and has conferred with the Chairman of the Salem and Beverly Water Supply Board and a representative from the town of Topsfield. After consideration it was voted to approve the plan submitted by the Salem and Beverly Water Supply Board under the provisions of chapter 700 of the Acts of the year 1913 subject to the following conditions:

1. The point of intake at the Ipswich River to be fixed at a subsequent time by the State Department of Health.
2. The times of pumping into the lake to be subject to the regulation of the State Department of Health.
3. The banks of the canal to be constructed and maintained in such manner and form as the State Department of Health shall direct, with a view to preventing water from the surface of Wenham Swamp from entering the canal.
4. A covered conduit or pipe line to be substituted for the open channel from the divide south of the proposed pumping station to Wenham Lake, the outlet to be placed at or near the shore of the lake about 400 feet south of Cedar Street.
5. Bacterial examinations of the water of Ipswich River and Wenham Lake to be made monthly and reported to the State Department of Health.

No provision is made in the plan for a measuring station, which remains to be established before water is diverted.

JUNE 23, 1915.

To the Salem and Beverly Water Supply Board, Salem, Mass., Mr. NATHAN MATTHEWS, Chairman.

GENTLEMEN: — The State Department of Health received from you on May 11, 1915, the following petition for the approval by this Department, under the provisions of chapter 309 of the Special Acts

of the year 1915, of the point of taking of the waters of the Ipswich River by the cities of Salem and Beverly.

The Salem and Beverly Water Supply Board hereby applies, under the provisions of special acts of 1915, ch. 309, to the State Department of Health for authority to take and divert the waters of the Ipswich River and its tributaries at a point approximately six hundred feet easterly of the bridge of the Newburyport branch of the Boston and Maine railroad over said river, as more particularly shown by a plan herewith submitted by Mr. F. A. Barbour of even date.

The petition was accompanied by a plan showing the proposed point of taking.

In response to this petition the State Department of Health has caused the locality to be examined by its engineer and on June 23, 1915, gave a hearing in regard to this question after notice to the Salem and Beverly Water Supply Board and to the boards of selectmen of the towns of Topsfield and Wenham. At this hearing no objection was made to the taking and diversion of the waters of the Ipswich River by the Salem and Beverly Water Supply Board at the point designated in the petition and shown upon the plan submitted therewith.

After consideration, the Department passed the following vote:

Voted, That the State Department of Health hereby designates as the point on the Ipswich River at which the Salem and Beverly Water Supply Board may take and divert the waters of the Ipswich River and its tributaries for the purposes set forth in chapter 700 of the Acts of the year 1913, as amended by chapter 309 of the Special Acts of the year 1915, a point on said river 600 feet easterly of the bridge of the Newburyport Branch of the Boston and Maine Railroad, as shown upon a plan filed in this office on May 11, 1915, entitled "Salem and Beverly Water Supply Board. Map to accompany application to State Department of Health under Special Acts of 1915, Chapter 309. May 11, 1915. F. A. Barbour, Engineer."

SALISBURY.

MAY 15, 1915.

To the Salisbury Water Supply Company, Salisbury, Mass.

GENTLEMEN: — In response to your request, the State Department of Health has considered your plan of water supply for the town of Salisbury on which you indicate as the source of supply ground water in the valley of Chase Pond Brook, so called, in the northerly part of the town, and has considered the results of the examination of the locality by members of the Department.

It appears from the information available that the watershed of

this brook is practically uninhabited and that the water flowing in the brook consists chiefly of ground water of good quality for the purposes of a public water supply. Measurements of the flow of the brook in the latter part of the year 1914, in a very dry season, indicate that the quantity of ground water obtainable in this valley is sufficient for the present requirements of the town of Salisbury.

In view of the circumstances, the Department approves the taking of ground water from the valley of Chase Pond Brook as a source of water supply for the Salisbury Water Supply Company, under the provisions of chapter 243 of the Special Acts of the year 1915.

When the works now under construction for obtaining ground water in this valley have been completed to such an extent as will make it practicable to determine the probable yield and the quality of the water, the Department will advise you further as to these works and as to extensions of the collecting system if and when such extensions are found desirable.

SANDWICH (MASSACHUSETTS VOLUNTEER MILITIA).

JULY 15, 1915.

TO FRANK P. WILLIAMS, M.D., *Colonel, Medical Department, M. V. M., Surgeon-General, State House, Boston, Mass.*

DEAR SIR: — In accordance with your request, the Commissioner of Health has caused a further examination of Peter's Pond in Sandwich to be made and samples of the water to be analyzed.

The results of the examination show that the conditions have not changed materially since the pond was examined by this Department two years ago. In its present condition it may safely be used as a source of domestic water supply. Whether or not it would be safe to use after a camp has been located near the shores would depend on the care that is taken to prevent the pollution of the water by bathing or by sewage or refuse from the camp. If the danger of such pollution is considerable, it would be advisable to install a few tubular wells and secure the water for the supply of the camp from the ground in that manner rather than from the pond.

It is understood that the pond is also used as a source of domestic water supply by one or more of the cottages near its shore, and it is important that danger of the pollution of the water supply of these cottages shall be prevented.

SOUTHBOROUGH (WINCHESTER PLACE).

JUNE 29, 1915.

To the Board of Health, Southborough, Mass., Mr. CHARLES F. CHOATE, Jr., Chairman.

GENTLEMEN:— In response to your request of May 27, 1915, for an examination of the water supply of the Winchester place on Main Street, Southborough, the Commissioner of Health has caused the locality to be examined by one of the engineers of the Department and samples of water from a well used as the source of water supply by the occupants of these premises to be analyzed.

The well from which the water supply is taken is the same source that was in use last year, and the results of the recent analyses again show that this water is grossly polluted and likely to injure the health of those who may use it for drinking. It is recommended that the further use of this well as a source of domestic water supply be effectually prevented.

The sewage of the buildings on the Winchester place is at present discharged into two cesspools, both of which are adjacent to a barn in the rear of the property and about 25 feet from the well.

The information submitted to the Department indicates that these cesspools have been in use for less than a year and that the sewage has overflowed upon the ground in their neighborhood and caused complaint from adjacent estates. At the time of the examination by this Department, the odor in the barn cellar was extremely offensive and the ground beneath a layer of sand in the bottom of the barn cellar was saturated with sewage. Sewage was also standing upon the surface of the ground at one or two points south of the barn, and there were indications that the sewage had percolated into the cellar of a building on adjacent property.

The past four months has been an exceptionally favorable time for the disposal of sewage by means of cesspools on this property on account of the fact that there has been an extreme deficiency of rainfall during this period; in fact, there has been almost a continuous deficiency in rainfall for a period of more than a year. Notwithstanding these favorable conditions, the quantity of sewage discharged from this property not only saturates the soil throughout a large portion of it, but causes the sewage to stand in places upon the surface of the ground.

These facts show clearly that it is impracticable to dispose of the quantity of sewage at present discharged from these buildings by means of cesspools within the property without causing a nuisance

in the neighborhood. In the opinion of the Department, the further occupancy of these buildings should be prevented until provision has been made for the disposal of the sewage in such a manner as will prevent further nuisance and danger to the public health.

To the Board of Health, Southborough, Mass.

AUG. 13, 1915.

GENTLEMEN: — In accordance with your request of July 23, the State Department of Health has caused the well near the highway on the Winchester place in Southborough to be examined and a sample of the water to be analyzed.

The well in question is of the ordinary type dug to a depth of about 28 feet and, when examined, contained from eight to ten feet of water. It is located very close to the street line and in a populous district. There are three cesspools on the property within a distance of less than 100 feet from the well.

The results of the analysis of the water show that it has been grossly polluted by sewage and is unfit for domestic use. The Department recommends that the further use of the water of this well for drinking and other domestic purposes be effectually prevented.

SOUTHBRIDGE (WELL).

AUG. 13, 1915.

To the Board of Health, Southbridge, Mass., Mr. ALBERT R. BROWN, Agent.

GENTLEMEN: — In response to your request for an examination of a well at a farmhouse in Southbridge, which you have reason to believe is seriously polluted, and also for an examination of a source of ice supply from which ice is taken for domestic purposes in the town, the State Department of Health has caused the localities to be examined and samples of the water and ice supplies in question to be analyzed.

An examination of the well, which is located on the Lombard place about a mile south of the center of the town, shows that there are sources of pollution in its immediate neighborhood, and an analysis of the water shows that it is grossly polluted and unsafe for domestic use. It is recommended that the further use of the water of this well for domestic purposes be prevented.

The source of ice supply referred to in your application is a reservoir which it appears was formerly used for the water supply of the town. The reservoir has considerable population on its watershed but there were no indications of serious direct pollution of the water at

the time of this examination. The sample of ice taken from the ice-house on the shore of the pond was found, upon examination, to be of good quality for domestic use.

In the opinion of the Department, this reservoir can safely be used as a source of ice supply while the conditions remain as at present. It is important, however, that snow ice, including the first inch of ice that forms upon the pond, be removed before using.

SOUTH HADLEY (SOUTH HADLEY FALLS).

JUNE 18, 1915.

To the Board of Water Commissioners, South Hadley Falls, Mass., Mr. CHARLES O'GARA, Chairman.

GENTLEMEN:— In response to your request of May 4, 1915, for advice as to the advisability of granting the request of a gas company asking permission to lay mains across Buttery Brook at two places, the Commissioner of Health has caused the locality to be examined and has considered the condition of the South Hadley water supply and the character of the water obtained from the sources now in use. There appears to be no reasonable objection to the construction of gas mains across Buttery Brook at the points proposed.

The results of the examination show, however, that there are many possible sources of pollution within the watershed of Buttery Brook and that there is much danger of injury to the health of the inhabitants of the town if the use of this source is continued under present conditions. The cause of this danger is due to the large population situated upon this watershed in the village of Fairview, located partly within the town of South Hadley and partly within the limits of the city of Chicopee. The city of Chicopee has recently constructed a sewer to remove the sewage from the portion of the Fairview watershed within the limits of that municipality, but nothing appears to have been done toward providing proper sewerage for the population within the limits of South Hadley.

It is probable that, if sewerage were provided in connection with the general sewerage system for all of the houses within this watershed in the village of Fairview, the danger of the pollution of the water supply would be lessened, though with so large a population on the watershed it will be extremely difficult to prevent all pollution of the brook which enters your reservoir.

In view of the circumstances, further provision should be made for the protection of the health of the inhabitants of South Hadley from the danger of the use of Buttery Brook Reservoir as a source of water

supply. This probably can be done by filtering the water supplied to the town, though the cost of construction and maintenance of filters would add considerably to the cost of your water supply system.

The examinations that have been made of the water of the Leaping Well Reservoir, which is also used as a source of water supply for South Hadley, show that this water contains at times excessive numbers of organisms which make the water very objectionable for domestic use, but, notwithstanding the growths by which this reservoir is affected, its water would doubtless be safer for drinking than that of the Buttery Brook Reservoir.

The Commissioner of Health recommends that an improved water supply be provided for the use of the town of South Hadley at the earliest practicable time, either by filtering the water of the present sources through proper filtration works, or by securing water of good quality from other sources.

STERLING (SPRING).

FEB. 24, 1915.

To the Board of Health, Sterling, Mass.

GENTLEMEN: — In response to a request from the State Inspector of Health for an examination of the water of a spring used as a source of water supply on the premises of Charles Greenwood where a case of typhoid fever recently occurred, the Commissioner of Health has caused the spring and its surroundings to be examined and a sample of the water to be analyzed.

The results of the analysis show that at the present time the water of the spring is of good quality and safe for domestic use.

An examination has also been made of the well at the Walton farm from which place milk was obtained for use by the Greenwood family. This well is located beneath the cellar of the house near the wall underneath the sink.

The analysis shows that the water is very badly polluted and unfit for use. It is recommended that the further use of the water of this well be prevented.

STOUGHTON (WELL).

JUNE 21, 1915.

To Mr. WILLIAM T. ALLEN, Stoughton, Mass.

DEAR SIR: — The Commissioner of Health, in reply to your request of May 29, 1915, for advice as to the use of the water of a well at Glen Echo Park in Stoughton, has caused the well and its surroundings to be examined and a sample of the water to be analyzed.

It appears that this well is likely to be used by a considerable number of people during the coming summer who live in cottages in the immediate neighborhood.

The results of the examination show that the water of the well contains more organic matter than is found in good well waters, but in the condition in which it was found at the time of the recent examination the water was probably safe for drinking. There are, however, numerous sources of pollution in the immediate neighborhood of the well when the cottages in its neighborhood are occupied in the summer season, and sewage is being discharged in a considerable quantity upon the ground about it. There is much danger that the quality of the water would deteriorate and the source become an unsafe one from which to take water for domestic purposes.

It is advisable that a water supply be provided for the use of the inhabitants of this neighborhood from a well or other source located at a sufficient distance from cottages or other buildings to prevent danger of the contamination of the water by sewage therefrom.

SUTTON (WELLS).

FEB. 5, 1915.

To the Board of Health, Sutton, Mass.

GENTLEMEN: — In response to a request from Mr. C. N. Woodbury of Sutton, the Commissioner of Health has caused an examination of a well on his premises to be made, and a copy of the recommendations of the Commissioner relative thereto is enclosed herewith.

During this investigation an examination was also made of the water of the town well located in front of the town hall on South Street near Main Street in Sutton. The results of this examination show that the water of the town well is of much the same character as that found in the Woodbury well and, in the opinion of the Commissioner, this well also is an unsafe source from which to take water for drinking.

It is recommended that the town take up at the earliest practicable time the question of providing an adequate public water supply for use in the thickly settled districts of the town. The Department will be pleased to assist in such investigations by making the necessary analyses of water from any sources which you desire to have considered and will advise you relative to a water supply when you have the results of investigations to present.

FEB. 5, 1915.

To Mr. C. N. WOODBURY, *Sutton, Mass.*

DEAR SIR: — In response to your request for an examination of a well recently put in at Sutton, from which you propose to sell water for drinking, the Commissioner of Health has caused the well and its surroundings to be examined and a sample of the water to be analyzed.

The results of the analysis show that the water contains a much larger quantity of organic matter and a larger number of bacteria than are found in good well waters and that it is also very hard.

Judging from the information presented, the well is sunk to a depth of about 180 feet, largely in rock, and an examination of the surroundings shows that sewage is discharged either upon or into the ground at a number of places at no great distance from the well by which the ground water is exposed to pollution. There are also other sources of pollution at no great distance and, under the circumstances, the well cannot be regarded as a safe source from which to take water for drinking and should not be used for that purpose.

TOWNSEND (TOWNSEND CENTER).

JULY 1, 1915.

To Mr. ALBERT S. HOWARD, *Townsend, Mass.*

DEAR SIR: — In response to your request of June 15, 1915, for advice as to the quality of the water of a well located between the Squannacook River and Wilson Brook which you propose to use as a source of water supply for certain dwelling houses in the village of Townsend Center, the Commissioner of Health has caused the well and its surroundings to be examined by one of the engineers of the Department and a sample of the water to be analyzed.

The results of the analysis of a sample of water taken from the test well show that, while some of the water entering the well has been slightly polluted, it has subsequently been well purified in its passage through the ground, and in the condition in which the water was found at the time of this examination it was safe for drinking.

The circumstances are such, however, that the character of this water will probably depend to a considerable extent upon the quantity of water drawn from the ground in this location. If the quantity drawn is limited to the amount required by the schoolhouse and one or two dwelling houses for domestic purposes, it is likely that the quality of the water will continue to be satisfactory while the conditions in this region remain as at the present time. If, however, a larger quantity of water should be drawn, there is danger that de-

terioration would occur on account of the nearness of the source to populated portions of the village of Townsend. Under the conditions, it is necessary that, if the water drawn from the ground in this locality is used for domestic purposes, the quantity be limited as suggested herein.

TYNGSBOROUGH (SPRING).

JULY 24, 1915.

TO DR. CHARLES E. SIMPSON, *State District Health Officer, Lowell, Mass.*

DEAR SIR: — In response to your request of July 8, 1915, the State Department of Health has made an examination of the water supplied to the family of H. F. Cady in Tyngsborough to determine whether it is affected by an excess of lead.

The results of the analyses show that the water is drawn through a lead pipe $\frac{3}{4}$ of an inch in diameter and about 1000 feet in length running to the house from a spring on the hill southwest of the buildings. The results of the analyses show that the water when standing over night contained nearly $\frac{3}{4}$ of a part of lead, and more than $\frac{1}{3}$ of a part of lead in 100,000 was found in the sample when the water was running. This is more than seven times the minimum quantity of lead known to have caused lead poisoning.

The quality of the water of the spring appears to be satisfactory in other respects, and if the pipe were changed and a pipe of other material substituted therefor, the water of the spring would probably be safe for drinking. A pipe of tin or of lead lined with tin would be satisfactory, but the most desirable pipe to use would be an iron pipe lined with cement. Such a pipe can be obtained ready to lay at a reasonable cost, and the substitution of such pipe for the lead would not involve an excessive expense.

It is recommended that the lead pipe be removed without delay and that the further use of this water for drinking and cooking be discontinued at once until a pipe which will not be attacked by the water has been provided.

WARREN.

MARCH 1, 1915.

To the Water Supply Committee, Warren, Mass., Mr. FRANK E. GLEASON, Chairman.

GENTLEMEN: — The Commissioner of Health has considered your application for advice with reference to a water supply for the town of Warren and has caused the locations in which investigations for a water supply have been made to be examined by the engineer of the Department and samples of water from test wells in these localities to be analyzed.

The sources now being considered with a view to obtaining a water supply for Warren are those which have already been considered in connection with previous investigations, viz., the region about Comins Pond south of the town and the valley of the Quaboag River north-east of the town.

The results of analyses of samples of water from test wells near Comins Pond indicate that the ground water in that region is of excellent quality for water supply purposes, and so far as these limited tests show, the soil conditions are favorable for obtaining water freely from the ground. The watershed is somewhat limited, however, and a thorough test will be necessary to determine whether an adequate quantity of water for the requirements of Warren can be obtained from the ground in this region.

The tests made in the valley of the Quaboag River above Warren indicate that the ground water in this region also is naturally of excellent quality for domestic purposes. The tests have not been carried far enough, however, as yet to show whether an adequate quantity of water for the supply of Warren can be obtained from the ground in this region, though one of the wells examined yielded water very freely when pumping with a hand pump.

From the investigations thus far made, it is likely that good water can be obtained in either location, but the conditions in the valley of the Quaboag River appear on the whole to be more favorable for obtaining an adequate quantity of water for Warren on account of the larger watershed available than is the case in the neighborhood of Comins Pond. It is recommended that you continue the investigations by sinking a sufficient number of test wells in the valley of the river above Warren to ascertain whether a porous stratum exists in this locality from which it is likely that an adequate quantity of good water can be obtained for the supply of the town. If as a result of further tests the conditions are not found to be favorable there, further tests should then be made in the valley near Comins Pond.

The conditions in the town of Warren are such that a public water supply is very greatly needed there for the adequate protection of the public health, and it is recommended that measures be taken to provide such a supply at the earliest practicable time.

The Department will assist you in further investigations, if you so request, by making the necessary analyses of water and will give you further advice with reference to a water supply for Warren when the results of further tests are available.

WAYLAND.

OCT. 22, 1915.

To the Wayland Water Board, Cochrutuate, Mass., Mr. CLARENCE S. WILLIAMS, Clerk.

GENTLEMEN: — The State Department of Health has considered your application of Oct. 4, 1915, as to a certain proposed plan of improving the water supply of Wayland, has considered the plan presented by your engineer, and has examined the results of analyses of the water of your present sources of supply.

The results of these analyses show that the water of the lower basin on Snake Brook, from which your supply is drawn, is one of the most highly colored waters used for water supply purposes in the State. The water is also at times affected by growths of organisms which impart to the water a disagreeable taste and odor. These conditions, while objectionable, are not known to be injurious to health, and since the water of your reservoir does not appear to be exposed to serious danger of pollution at the present time, the water is undoubtedly safe for drinking.

The water of the upper basin, so called, located just above the lower basin, is more highly colored and contains a larger quantity of organic matter than the water in the lower basin, and there is furthermore a swamp above the upper basin having an area of about 32.4 acres, through which the water flows very slowly, and it undoubtedly derives a large part of its color and organic matter through contact with the vegetable matter in this swamp.

According to the reports relating to the water works, a large part of the original area flowed by the reservoir was covered with a thick vegetable growth when the reservoir was originally constructed, but since that time considerable money has been expended in improving the lower basin and removing mud and other organic matter from the shallow portions. The upper basin, however, is still quite shallow and has a mud bottom.

The plan now submitted provides for the construction of a small dike across the lower end of an arm of the lower basin through which the water of the upper basin overflows and for laying a pipe from the wasteway of the lower basin up to a manhole to be constructed on the west bank of the upper basin just above the proposed dike. This pipe is designed to remove flood waters, which would naturally pass through the lower basin around that basin to an outlet into the wasteway below the dam. The proposed pipe line and appurtenances appear to be adequate for the purpose for which they are designed, the

cost of the works would be comparatively small, and it is probable that the construction of these proposed works would result in some improvement in the quality of the water supplied to the town, but the water would undoubtedly continue to be highly colored and would contain at times growths of organisms which would impart to it a noticeable taste and odor. The improvement would be more effective if, in addition to the proposed works, the swamp above the upper basin were properly drained so that water from the watershed about it would be conveyed quickly to the reservoir and water were prevented from standing upon the swamp for any considerable time, but even with this improvement added, the water supplied to the town would still have the characteristics which make it objectionable at the present time, though in a less marked degree.

The water could be materially improved by proper filtration, but filtration is impracticable without pumping since the head under which the water is supplied is naturally very small.

In view of the unsatisfactory quality of the water and the low pressure under which it is supplied, and especially in view of the probable cost of an effective improvement of this water, it seems advisable for the town to investigate the practicability of securing a supply of ground water either from Natick, from which water is obtained occasionally under present conditions, or from independent works, which might be located in the neighborhood of Lake Cochituate at no great distance from the village. The initial cost of a new supply would not be great and, while there would be the added cost of pumping, it would be practicable to extend the works to supply other very thickly settled portions of the town, and the cost of a new supply under the circumstances would not be likely to be a serious added burden above the cost of the improvements proposed in the present source.

Considering the circumstances, it is the opinion of this Department that it is inadvisable to attempt improvement of the present supply unless the improvement is going to be great enough to insure a water of satisfactory quality, and the Department recommends that you investigate the practicability and cost of obtaining a water supply from the town of Natick or from independent sources in the neighborhood of the village, designing the works with a view to supplying other portions of the town, to which it is advisable that the public service be extended.

WELLESLEY.

OCT. 21, 1915.

*To the Water and Electric Light Department, Wellesley, Mass., Mr. CHARLES E. FULLER,
Manager.*

GENTLEMEN: — In response to your request for an examination of the water of certain new tubular wells shown on a plan submitted with your application which you desire to add to the collecting system of water supply for the town of Wellesley, the State Department of Health has caused the wells and their surroundings to be examined and samples of the water to be analyzed.

The results of the examination show that these wells are located south of Worcester Street a short distance below Longfellow's Pond in a region at present free from possible sources of pollution. The wells vary from 28 to 40 feet in depth and yielded water very freely when pumped with a hand pump. They are sunk in porous material and are likely to furnish a considerable addition to the yield of your present system of water supply.

Analyses of the water of the wells indicate that it is of about the same quality as that of your present system and, in the opinion of the Department, these wells are suitable sources from which to take an additional water supply for Wellesley.

An examination has also been made, in accordance with your request, of the water of the old filter gallery near the pumping station, the results of which show that this water at the present time is of good quality and safe for drinking. It is possible that a continued draft from the filter gallery may be followed by a change in the character of the water, and it is advisable, if water is to be drawn from this source, that it be analyzed from time to time in order that its use may be discontinued if the quality should deteriorate to such an extent as to require such action.

An analysis of the water of the new driven well on the Morse land on the southerly side of Rosemary Brook indicates that the ground water in this locality is probably of good quality for domestic purposes.

WELLESLEY (METROPOLITAN PARK RESERVATION).

JUNE 9, 1915.

To the Metropolitan Park Commission, Boston, Mass.

GENTLEMEN: — The State Department of Health received from you through Mr. John L. Gilman, Superintendent Charles River Upper Division of the Metropolitan Park Reservation, an application for an

examination of a spring located in the Metropolitan Park Reservation in Wellesley and advice as to the quality of the water for drinking, and in response to this application the Commissioner of Health has caused the spring to be examined and a sample of the water to be analyzed.

The results of the analysis show that the water of the spring has been at some time polluted but subsequently quite well purified in its passage through the ground before entering the spring, and in the condition in which it was found at the time of this examination the water was probably not injurious for drinking. There are several dwelling houses on the ground not far from the spring the sewage from which is disposed of in cesspools, two of them within about 160 feet of the spring, and it is possible that the quality of the water may deteriorate and the water become unsafe for drinking.

If the use of the water is to be continued, it should be analyzed from time to time and, if serious deterioration occurs, its further use for drinking prevented.

WESTFIELD.

APRIL 1, 1915.

To the Board of Water Commissioners, Westfield, Mass., Mr. JOHN L. HYDE, Engineer.

GENTLEMEN: — In response to your request for advice as to improving the water supply of Westfield by metering the services and by the construction of a storage reservoir on the Granville supply, the Commissioner of Health has examined the information presented as to the water supply of Westfield and has considered the conditions affecting the purity of your sources of supply.

The supply is now drawn in part from a storage reservoir in Montgomery, the capacity of which is given as 184 million gallons, in part from a distributing reservoir, holding about 4,500,000 gallons, two miles below the storage reservoir, and in part from the watershed of Tillotson Brook and an adjacent stream known as Japhet Brook, having an aggregate drainage area of 6.25 square miles, on which there are no storage reservoirs.

It appears that during the dry summer and autumn of 1914 the quantity of water used was such as to reduce the amount available in your storage reservoir to 76 million gallons, and you estimate that if business conditions had been normal the amount would have been reduced to less than 50 million gallons. In either case the quantity of water available in the latter part of 1914 was too small to be regarded as an adequate provision for an emergency in a growing town like Westfield. With normal business conditions, had the dry season

begun earlier or continued longer, as has been the case in certain earlier years for which records of rainfall are available, the town would undoubtedly have experienced a shortage of water.

The plan of metering all of the services in the town, which it is understood you now propose, is an excellent one to adopt under the circumstances, since, unless meters are introduced, the consumption of water will inevitably increase and become very excessive at no distant time. The quantity of water used per capita in 1914 in the town of Westfield exceeded considerably the maximum consumption of water in any city or town in the State in which practically all of the services are metered, and the general use of meters in Westfield would undoubtedly reduce very considerably the quantity of water required for the supply of the town. The amount of reduction in the consumption of water that could be effected by the general use of meters cannot be very definitely predicted. It appears that 21.6 per cent. of the quantity of water used in 1914 passed through 69 meters, indicating that there are a number of large users of water in the town, and it is not to be expected that any permanent reduction would be effected in the use of water by manufacturers in the future. It is likely, on the contrary, that the amount will increase materially as business conditions improve. Nevertheless, the general introduction of meters will undoubtedly effect a considerable saving in the use of water, possibly as much as 20 per cent. in the beginning, and, while the consumption of water per capita will doubtless increase in the future, the general metering of the supply will prevent the use of water from becoming excessive.

Even if meters are generally applied, the necessity for provision for an additional supply will not be postponed, since if the town continues to grow the increase in the consumption of water will in any case require an enlargement of the supply in the immediate future.

The plan of enlarging the supply by the construction of a reservoir at the Junction site, so called, above the present point of intake on Tillotson Brook, has been carefully investigated, and you have already been advised by this Department that this site is the most favorable location at which to construct a reservoir, and this method appears to be the best practicable plan of increasing the water supply of the town. The adoption of this plan will also have the very great advantage that it will provide for improving the quality of the water on this watershed by storage before it is introduced into the town. A storage reservoir of the capacity proposed would be a most potent instrument in the destruction of disease-producing bacteria, and the construction of the proposed reservoir on this watershed would elim-

inate the great danger that now exists of pollution of the water of this source by visitors to the watershed and by the inhabitants still dwelling upon it.

In view of all the circumstances, it appears to the Department of the highest importance, both in providing an adequate water supply for the future requirements of this growing town and for the protection of the health of the users of water, that the work of the construction of this reservoir be begun without delay and completed at the earliest practicable time.

WESTON (HUBBARD ESTATE).

Oct. 22, 1915.

TO MR. CHARLES W. HUBBARD, *Weston, Mass.*

DEAR SIR: — In accordance with your request for an examination of the condition of your water supply, which supplies some twelve dwelling houses in Weston, and advice as to its quality, the State Department of Health has caused the sources of supply to be examined and samples of their waters to be analyzed.

The sources examined are three wells located in the valley of a small tributary of Charles River which enters that stream about 800 feet above the Park Road Bridge. The principal well, which is located at a point about 1,600 feet from the river and about 25 feet south of the brook, is about 12 feet in diameter and about 25 feet in depth, having been sunk to ledge. There appear to be no dwelling houses on the watershed of this well, and analyses of the water show that at the time of this examination it was of good quality for domestic use.

The remaining wells are located near the mouth of the brook, one about 350 feet and the other about 150 feet from the river. There appear to be no sources of pollution in the region about these wells, and an analysis of the water of the lower well indicates that the water is of good quality for domestic use.

The well located about 300 feet from the river is used but little at the present time and was not examined. The quality of the water at the time of a former examination was found to be satisfactory.

An analysis of a sample of water taken from the house of one of the water takers to determine the probable cause of criticism of the quality of the water shows the condition of the water at this place to be much the same as that in the well. The water contained a somewhat greater quantity of iron than is found in the water from other points on the system, and it is not unlikely that criticism of the

quality of the water may be due to lack of flushing of the pipe through which the water is supplied.

It is probable that a thorough flushing at such intervals as may be found necessary would remove any possible cause of complaint.

WESTON (BLAKE ESTATE).

JUNE 4, 1915.

To the Board of Health, Weston, Mass., Mr. ROBERT N. HOYT, Agent.

GENTLEMEN: — In response to your request for an examination of the water supply of the Blake estate in Weston and advice as to its use for domestic purposes, the Commissioner of Health has caused the source of supply indicated to be examined and samples of the water to be analyzed.

According to the information available, this water supply is taken from a well 20 feet in diameter and 34 feet deep, from which the water is pumped to an open reservoir having a capacity of 250,000 gallons, whence it is supplied to some twenty water takers, the total quantity of water used averaging somewhat over 13,000 gallons per day. There appear to be no sources of pollution on the watershed of the well, and analyses of the water indicate that it is of good quality for domestic use. The water as stored in the reservoir deteriorates somewhat on account of its exposure to light and is apparently affected somewhat by growths of microscopic organisms, the presence of which in water used for drinking is not known to be injurious to health.

In the opinion of the Commissioner of Health, this source of water supply is safe for domestic use and can continue to be used with safety while the conditions about it remain as at the present time.

WESTON (RIVERSIDE RECREATION GROUNDS).

JULY 23, 1915.

To the Metropolitan Park Commission, 14 Beacon Street, Boston, Mass.

GENTLEMEN: — In response to your request for advice as to a proposed water supply for the Riverside Recreation Grounds in the town of Weston, the State Department of Health has examined the results of a test made by pumping from a group of three wells on the south-westerly bank of the river just below the railroad embankment of the Boston & Albany Railroad, and has caused the locality to be examined by one of its engineers.

It appears that a group of three tubular wells $2\frac{1}{2}$ inches in diameter have been sunk at the location indicated to a depth of about 37 feet

at a point about 100 feet below the foot of the railroad embankment and 35 feet from the river. These wells are said to have penetrated a stratum of coarse sand after passing through about 17 feet of river silt and 13 feet of very fine sand or clay. A test of the yield of these wells was made on June 18 and 19 by pumping continuously from the wells for a period of 31 hours at a rate of about 68,000 gallons per day, and samples of water were collected during the course of this test.

The results of the analyses show that the water, while somewhat harder than the waters obtained from this valley for the supplies of Dedham, Newton, Brookline and Waltham, is on the whole of good quality and suitable for domestic use. The results of the test indicate, furthermore, that an ample quantity of water for the present requirements of the Recreation Grounds can be obtained from wells in the location in which this test was made.

The only important sources of pollution in the region about these wells are the cesspools on the Recreation Grounds, and it is understood that provision has been made for discontinuing the use of these cesspools and discharging the sewage into the sewerage system of the city of Newton.

Under these conditions and in view of the results of the test, the Department is of the opinion that water from wells in the location in which the test was made may safely be used for drinking and other purposes on the Recreation Grounds.

WESTPORT (WELLS).

MAY 15, 1915.

To the Board of Health, Westport, Mass.

GENTLEMEN: — In response to your request for an examination of certain wells in Westport at houses in which cases of typhoid fever have occurred, the Commissioner of Health has caused the wells indicated to be examined and samples of their waters to be analyzed.

Three of these wells, located respectively at the houses of Manuel Perry, Frank Verria and Anton Verria, have been examined at previous times. The well of Manuel Perry, concerning which the State Board of Health advised on Oct. 7, 1912, that the further use of the well should be discontinued, shows by the recent examination a very great deterioration in quality, indicating that its use is unsafe. The previous recommendation of this Department should be immediately carried out and the further use of this water for drinking or other domestic purposes prevented.

The well at the premises of Anton Verria was found to be so objec-

tionable at the time of the previous examination in 1913 that it was recommended that the further use of this well should be discontinued. The recent examination again shows that the water of this well is grossly polluted, and the recommendation of the Department made two years ago should be carried out at once.

The well at the premises of Frank Verria shows no great change from its condition at the time of the previous examination. Certain improvements recommended at that time have been made, but others have not yet been carried out. It is probable that this well might be used with safety for drinking if the stone curbing of the well were laid up in cement mortar from a level 3 or 4 feet below the present top of the well to a height of a foot above the surface of the ground about it to prevent the entrance of surface water, and by covering the well so as to prevent pollution getting into it from the top, as advised in the communication of this Department on June 16, 1913.

The well on the premises of Clifton L. Tripp appears to be so located that it is not exposed to serious danger of pollution by sewage from the house or barn. This well could probably continue to be used with safety, provided it is properly walled up and covered as recommended in the case of the well of Anton Verria. A pump should be provided at this well so arranged that the waste water will not flow back through the platform into the well. With the changes suggested, the water of this well may probably be used with safety.

To the Board of Health, Westport, Mass.

JUNE 15, 1915.

GENTLEMEN: — In response to your request for an examination of the water of a well located west of the barn on the premises of Anton Verria, the Commissioner of Health has caused the well to be examined and samples of the water to be analyzed.

There are sources of pollution at no great distance from the well, and the analyses show that the water is grossly polluted and unsafe for drinking and other domestic purposes.

The character of the water of the other well on these premises, referred to in the communication of this Department under date of May 15, 1915, is such that it is not probable that any cleaning such as you suggest would be likely to result in securing water from this well which would be safe for drinking and other domestic purposes.

In addition to the foregoing, the following cities, towns and persons have been advised relative to spring waters, waters used for the supply of factories, public wells or wells used by a number of families; but

as these matters are for the most part of minor importance, the communications have not been printed. Copies of them are on file in the office of the Department: —

Arlington, well.

Attleboro, well of J. E. Blake Company.

Attleboro, well in Hebronville.

Bridgewater, well.

Canton, well and spring of American Fireworks Company.

Chelmsford, wells (two).

Chelsea, well of Rossi Brothers Company.

Dana, springs at Dana Center School.

Dracut, well at Kenwood School.

East Longmeadow, well.

Fairhaven, well at Fort Phoenix.

Framingham, well in Saxonville.

Gardner, well.

Georgetown, wells (two).

Hanover, wells (two).

Holyoke, well of Valley Paper Company.

Hubbardston, well.

Ipswich, well at Rose Tree Inn (two).

Lawrence, well at Everett Mills.

Lawrence, well at Wood Worsted Mills.

Lawrence, well at Washington Mills.

Lenox, spring in Lenox Dale.

Lowell, water supply of United States Cartridge Company (two).

Lowell, spring.

Lynn, well of H. P. Hood & Sons.

Marshfield, well of Webster Terrace Land Company.

Medfield, well.

Medford, Fulton Spring.

Milton, well.

North Attleborough, well of The Webster Company (two).

Norwell, well at District No. 1 School.

Orange, well at North Orange School.

Peabody, Crystal Spring.

Reading, well.

Rowley, well of H. C. Foster.

Salem, springs.

Somerset, well.

Southborough, well.

South Hadley, well at Hadley Mills.

Swansea, well at Swansea Dye Works.

Templeton, well in Baldwinsville.

Tewksbury, wells at schools.

Watertown, well.
Webster, well.
West Newbury, well.
Weston, well at boys' camp.
Wilmington, well at High School.
Winchendon, wells.

ICE SUPPLIES.

The following is the substance of the official action taken during the year in reply to applications for advice relative to ice supplies: —

COLRAIN.

DEC. 16, 1915.

To Mr. GEORGE S. MATHYS, *Colrain, Mass.*

DEAR SIR: — In response to your application for advice as to the use of ice to be cut from a pond on the Deerfield River for domestic purposes, the State Department of Health has caused the pond and its surroundings to be examined and has considered the results of analyses of the water of the river, by which the pond will be chiefly supplied.

The pond is located below one of the main dams on the Deerfield River by means of which the water is diverted into the stream at a point considerably below the pond from which the ice is to be taken.

Under the circumstances, the water of the pond will be made up of water occasionally overflowing or leaking past the dam above the pond and water from the tributary watershed between the dam and the pond. The Deerfield River receives very little pollution above this ice pond, and the local watershed is practically free from sources of pollution. At times of freshet, however, or overflow from the river above at a time when ice has formed on this pond, the ice may become flooded by river water.

In view of the conditions, the Department is of the opinion that the only practicable way of obtaining ice of good quality for domestic purposes from this pond will be to remove the first inch of ice that forms upon the pond, and also all ice that forms above it by flooding, and to retain for use only the clear ice that forms beneath the first inch. It is also important that all ice containing particles of foreign matter be rejected.

If these recommendations are followed, it is probable that the clear ice from this source may safely be used for domestic purposes.

DUXBURY.

MARCH 26, 1915.

TO MR. CHARLES W. EATON, *Secretary, Board of Health, Duxbury, Mass.*

DEAR SIR: — In response to your request of March 3, 1915, for an examination of Tack Factory Pond, so called, and advice as to its use as a source of ice supply, the Commissioner of Health has caused the pond and its surroundings to be examined and samples of the water and ice to be analyzed.

The results of these examinations show that the pond is not exposed to serious danger of pollution and the ice taken therefrom is of good quality for domestic use.

You have also requested an examination of the water of a well at Chase's Bog, so called, used for drinking and domestic purposes by the inhabitants of buildings in that locality.

The results of an examination of this well show that there are sources of pollution in its immediate neighborhood, and an analysis of a sample of the water shows that it is grossly polluted and unfit for domestic use. It is recommended that further danger of the use of the water of this well for drinking and other domestic purposes be prevented.

FALMOUTH.

FEB. 2, 1915.

TO THE BOARD OF HEALTH, *Falmouth, Mass.*, MR. T. L. SWIFT, *Chairman.*

GENTLEMEN: — In response to your request for an examination of Nye's, Morse's and Jones's ponds and advice as to their use as sources of ice supply, the Commissioner of Health has caused an examination of these ponds to be made and samples of the water and ice therefrom to be analyzed.

The results of the analyses show that the ice taken from each of these ponds was practically free from bacteria and of good quality for domestic use.

A further examination has also been made of the ice from Shiverick's Pond, which has been examined in previous years. The results show that the ice formed there during the present season is of good quality for domestic use, the ice both at the surface and bottom of the cake having been found to be practically free from bacteria.

In using ice from these ponds, all snow ice and ice containing particles of foreign matter should be rejected.

FRANKLIN.

MAY 24, 1915.

To the Board of Health, Franklin, Mass., Mr. J. NEWTON BLANCHARD, Agent.

GENTLEMEN: — In response to your request for an examination of Green's Pond, so called, located about a mile south of the railroad station in Franklin, and advice as to its use as a source of ice supply for domestic purposes, the Commissioner of Health has caused the pond and its surroundings to be examined and a sample of the water to be analyzed.

The results of the analyses show that the water at this time was highly colored and contained a large quantity of organic matter, much of which was apparently of vegetable origin.

There is a piggery, together with several receptacles for sewage, in the immediate neighborhood of the pond which it is understood the owner proposes to remove before the pond is used as a source of ice supply.

In the opinion of the Department, judging from the results of the examination of the locality, there is no reason to doubt that, if all of the sources of pollution in the immediate neighborhood of the pond were removed and the watershed kept free from pollution, the pond might safely be used as a source of ice supply for domestic purposes.

GREENFIELD.

APRIL 29, 1915.

To the Board of Health, Greenfield, Mass.

GENTLEMEN: — At the request of Dr. Lyman A. Jones, State Inspector of Health, this Department has considered the question of the probable effect of the location of a piggery at the Hawkes place, on the Turners Falls Road, upon the use of Graves Pond, so called, as a source of ice supply.

The information presented indicates that the place is to be used as a piggery for the disposal of the garbage of the town and that the pigs will have access to the small brook flowing from Maynard Pond into Graves Pond. A recent examination has shown that Graves Pond is not exposed to danger of serious pollution which would affect the safety of its use as a source of ice supply, provided the ice were treated in the manner recommended in a communication from this department on April 28, 1913. It is very probable, however, that if the location proposed should be used as a piggery, the brook entering the pond would be seriously polluted and the pollution of the pond

might become so serious as to make it an objectionable source from which to take ice for domestic purposes.

In locating a piggery for the purpose proposed it is important that it should not be so placed as to pollute any pond, spring or stream used as a source of water or ice supply for domestic purposes.

AUG. 13, 1915.

To the Board of Health, Greenfield, Mass.

GENTLEMEN: — In response to your request for an examination of ice ponds used by the Greenfield Ice and Trucking Company as sources of ice supply for domestic use and for the Boston & Maine Railroad, the State Department of Health has caused the sources of supply to be examined and further samples of water and ice from one of the sources to be analyzed.

It appears from this examination that there has been no material change in the conditions affecting the use of Wrights Pond and Maynard Pond as sources of ice supply since the last examination of those sources was made, and the Department sees no reason to amend the advice already given to your Board relative to the use of ice from those sources.

The examination of Graves Pond shows that, while there have been some changes within its watershed, the soil in the area about the pond is quite porous and there is no indication that the water is being polluted to such an extent as to affect the quality of the ice at the present time. An analysis of a sample of ice from this pond shows that its quality is, on the whole, somewhat better than at the time of the previous examination in 1913. In the opinion of the Department the ice from this pond may safely be used for domestic purposes provided the recommendation contained in the previous reply is carried out, — that is, that all snow ice, including the first inch of clear ice that formed upon the pond, be removed before using and all ice containing particles of foreign matter be rejected.

HARVARD.

MAY 24, 1915.

To Mr. L. KINGSTON SAVAGE, Harvard, Mass.

DEAR SIR: — In response to your request for an examination of Bare Hill Pond and advice as to the quality of the ice cut therefrom, the Commissioner of Health has caused the pond and its surroundings to be examined and samples of the water and ice to be analyzed.

The results of the analyses show that there is very little pollution

of the pond in the season of the year when ice is cut, and the circumstances are such that the ice is not exposed to serious danger of pollution.

The results of an analysis of a sample of the ice show that it is of good quality for domestic purposes.

It is advisable in selling ice from this source to remove from the ice, before using, all of the snow ice, including the first inch of clear ice that formed upon the pond. It is also recommended that all ice containing particles of foreign matter be rejected.

MANSFIELD.

Oct. 21, 1915.

To the Board of Health, Mansfield, Mass.

GENTLEMEN: — The State Department of Health has considered your application for advice as to the character of the ice taken from certain ponds in Mansfield and has caused the ponds and their surroundings to be examined and samples of the water and ice to be analyzed.

Willis Pond, one of the sources concerning which information is desired, is located on a small tributary of the Canoe River in the northeasterly part of the town. Its watershed contains few habitations and the water is not exposed to serious danger of pollution. The pond is quite shallow, however, and the ice in an ice house near the shore of the pond appeared to contain considerable foreign matter. An analysis of a sample of this ice shows that it contains more organic matter and a larger number of bacteria than are found in good ice. It is probable, however, that ice which could safely be used for domestic purposes could be obtained from this pond, provided all snow ice and the first inch of clear ice that formed upon the pond be removed before using and all ice containing particles of foreign matter rejected.

Kingman & Hodges' Pond, another source concerning which advice is desired, is located on the Rumford River in the southerly portion of the village of Mansfield. The watershed of this pond includes a large part of the villages of Foxboro and Mansfield and contains within its limits probably 3000 persons. One of the tributaries of this pond is polluted by sewage discharged from the town of Foxboro, and this and other tributaries receive considerable pollution in the course of their flow through the town of Mansfield.

At the time of a previous examination in 1905 your board was advised that "The analysis shows the first inch of ice frozen and the snow ice above to be dangerously polluted and unfit for use. The

clear ice below the first inch might be used if free from foreign matter." The results of the recent examination show that the pollution of the pond has increased and analyses of the water and of ice cut therefrom show that, while the ice might be used for refrigerating purposes, it cannot be considered safe for domestic use where it is likely to come in contact with food or be placed in drinking water.

NEWTON.

OCT. 19, 1915.

To the Crystal Lake Ice Company, Newton Center, Mass., Mr. ROBERT M. CLARK, Treasurer and General Manager.

GENTLEMEN: — In response to your request for an examination of Crystal Lake in Newton and advice as to its use as a source of ice supply, the State Department of Health has caused the lake to be examined and samples of the water and ice to be analyzed.

The region about Crystal Lake is quite thickly populated but is quite thoroughly sewered, and the results of an analysis of the water do not show evidence of serious pollution. The analysis of a sample of ice collected from an ice house near the shore shows that it is of good quality for domestic use.

In the opinion of the Department, ice which may safely be used for domestic purposes can be obtained from this lake, provided the first inch of ice that forms upon the lake, together with all ice that forms above it, is removed before using and that ice containing particles of foreign matter is rejected.

PALMER.

DEC. 22, 1915.

To the Board of Health, Palmer, Mass., Mr. W. C. HITCHCOCK, Clerk.

GENTLEMEN: — In response to your request, the State Department of Health has caused an examination to be made of a pond on Burleigh Brook, located about $1\frac{1}{2}$ miles north of the village of Palmer, and also of the watershed tributary thereto.

The examination shows that the watershed of the brook contains no dwelling houses from which sewage might pollute the stream, and the pond is, in the opinion of the Department, a suitable source from which to take ice for domestic purposes. It is recommended that in using the ice from this source the first inch of ice that forms upon the pond and all snow ice forming above it be rejected, including all ice containing particles of foreign matter.

If these recommendations are observed, this pond can be used with safety as a source of ice supply.

PEPPERELL.

MAY 6, 1915.

To the Board of Health, Pepperell, Mass.

GENTLEMEN: — In response to your request of April 23, 1915, for an examination of the ice contained in the ice house of S. M. Nokes, recently destroyed by fire, the Commissioner of Health has caused the locality to be examined and samples of the ice to be analyzed.

The results of this examination show that the samples of ice examined were of good quality for domestic use and free from objectionable odor. In the opinion of the Department, this ice can safely be used for domestic purposes.

PITTSFIELD (BERKSHIRE STREET RAILWAY COMPANY).

FEB. 26, 1915.

To the Berkshire Street Railway Company, Pittsfield, Mass.

GENTLEMEN: — In response to your request for an examination of the spring of Daniel C. French, having an outlet near the Monument Mills Power Company's plant in Glendale in the town of Stockbridge, and advice as to the use of the water for drinking in the cars used in interstate traffic, the Commissioner of Health has caused the source indicated to be examined and a sample of the water to be analyzed.

The results of the analysis show that the water of the spring, though very hard, is clear and colorless and contains little organic matter and is probably safe for drinking.

Your application also requests advice as to the quality of the ice taken from Hart's Pond near the village of Housatonic in the town of Great Barrington, and an examination of the water and ice of this source has also been made by direction of the Commissioner of Health.

The results of the examination show that the ice formed upon this source during the present winter is of good quality for domestic use. There are few houses in the neighborhood of the pond and one privy within 200 feet of its shores. While the ice formed during the present winter is satisfactory, it is advisable that the possible sources of pollution on the shores of the pond be examined during the coming summer and steps taken to prevent danger of the direct pollution of the water of the pond.

SALISBURY.

FEB. 20, 1915.

To Mr. ENOCH E. SAWYER, *Ferry Road, Salisbury, Mass.*

DEAR SIR:— In response to your request for an examination of Getchell's Pond in Salisbury and advice as to its use as a source of ice supply, the Commissioner of Health has caused the pond and its surroundings to be examined and samples of the water and ice to be analyzed.

The results of the examination show that, while the ice contains a somewhat greater quantity of organic matter than is found in good ice, it is of good quality for domestic use. It is probable that ice harvested from this source may be used with safety for domestic purposes, provided that the first inch of ice that forms upon the pond, including all snow ice, be removed before using and all ice containing particles of foreign matter be rejected.

SOUTHBRIDGE (see page 133).

SPRINGFIELD.

OCT. 22, 1915.

To Mr. EDWARD FITZGERALD, *Indian Orchard, Mass.*

DEAR SIR:— In response to your request for an examination of a proposed location for a reservoir on Bircham Bend Brook, from which you propose to take ice for domestic purposes, the State Department of Health has caused the locality to be examined by one of its engineers and a sample of the water of the brook to be analyzed.

The results of the examination show that the watershed contains but little population, and with a suitable reservoir it is probable that ice which is safe for domestic purposes can be obtained from this source.

An examination has also been made of the proposed location of the reservoir from which the ice is to be taken. According to information submitted, the reservoir will be about 10 feet deep at the dam and 4 feet deep near the upper end, and the area is to be cleared of objectionable organic matter when the reservoir is constructed.

It is probable that with the proposed reservoir as described ice can be obtained from Bircham Bend Brook at the location indicated which will be of good quality for domestic purposes.

SEWERAGE AND SEWAGE DISPOSAL.

The following is the substance of the official action taken during the year in reply to applications for advice relative to sewerage and sewage disposal: —

AMHERST.

FEB. 25, 1915.

To Mr. C. R. ELDER, *Chairman, Sewer Commissioners, Amherst, Mass.*

DEAR SIR: — The Commissioner of Health has considered your application of Jan. 23, 1915, for advice relative to the disposal of the sewage of Amherst by various methods available and the plans and information relative thereto and has caused the locality to be examined by one of the engineers of this Department.

The sewerage system of Amherst has been under construction for many years and at the present time the sewage from about one-third of the inhabitants of the sewered districts is conveyed by gravity to the Connecticut River, while the greater portion of the sewage from the remaining population is discharged upon filter beds located near East Street, though small quantities of sewage are also disposed of upon small filter beds off Pleasant Street and off Dana Street, the latter beds being near the densely populated part of the village. The area of filter beds at the principal disposal area — that at East Street — is now about two acres. The material of which these filters are composed is rather fine but well suited for the purification of sewage if applied at a proper rate. The filters are capable of being operated efficiently at a rate of about 40,000 gallons per acre per day and, though they may be operated for short periods at a greater rate, it will not be practicable to maintain a materially higher rate of operation than that indicated and secure a satisfactory effluent.

The quantity of sewage discharged at this area, as shown by various measurements, has ranged from 140,000 to more than 600,000 gallons per day, and during a large part of the year the average quantity is too great for purification on the present filters. This variation is caused by excessive leakage into the main sewers, and if it is decided to continue the treatment of the sewage at the present disposal works it will probably be less expensive to relay the main sewer than to construct an adequate area of filter beds for the purification of all of the sewage.

It is probable that, if the sewers were relaid and made tight, the

maximum flow of sewage would be greatly reduced, but it would still no doubt be necessary to provide at least six acres of filters for the proper treatment of the sewage. The total cost of relaying the main sewers, making the necessary improvements in the existing works and constructing the additional works necessary to provide for the proper treatment of the sewage at this area, would probably amount to at least \$28,500, and additions of course will be required to the filter beds from time to time in the future if the town continues to grow.

The estimated cost of extending a branch sewer from the main trunk sewer leading to the Connecticut River to the junction of the Snell Brook sewer is estimated by your engineer at about \$20,000, while the cost of extending the sewer around Amherst College to a connection with the Central or Maple Brook sewer would add about \$6,000. These extensions would serve about 2,000 people, and, by extending the main sewer in the form of an inverted siphon across the valley of Maple Brook through Dickinson Street, a considerable additional population would be served. The estimated total cost of these extensions as given by your engineer is \$28,000. These extensions would have the advantage of providing sewerage for houses in the westerly section of the town, especially on Northampton, Amity and Brighton streets, Sunset Avenue and Pine Court. It would also make it practicable to provide sewerage for Amherst College and finally to discontinue the use of the Dana Street filtration area, which is undesirably near the thickly settled part of the town. If this plan were carried out, not only would the expense of enlarging and improving the East Street area be avoided, but the increased cost of maintenance of that area would also be avoided. There would still be a small population which would continue to drain most readily to the East Street filters, but this population would be so small that the present filters could probably be utilized to care for the sewage therefrom for several years in the future, and if it should be found desirable at any future time, the use of the East Street area could be wholly discontinued and the disposal of the remaining sewage that would be tributary thereto could be effected by pumping it into the Connecticut River system.

There is no question that, if the town is to continue to discharge sewage at the East Street filtration area, a great addition to this area must be made without delay, and provision must also be made for the proper care and maintenance of these filters at all times.

Under the circumstances, it is probable that the most satisfactory and economical method of disposing of the sewage of Amherst will be to discharge it into the Connecticut River through an extension

of the sewers now connected with that outlet. It is recommended that works be constructed during the coming year for the diversion of all of the sewage practicable from the East Street filters into the Connecticut River and that the sewage now discharged at the Dana Street filters be discharged into the new system and the use of those filters discontinued.

If this recommendation is adopted, provision should still be made for maintaining the East Street filters in the most efficient possible condition during the time that must elapse before the sewage is diverted into the Connecticut River system.

ANDOVER.

JAN. 18, 1915.

To the Board of Public Works, Andover, Mass.

GENTLEMEN:—Complaint has been made to this Department by certain residents on Central Street in Andover that sewage has overflowed from the Phillips low level pumping station of the Andover sewerage system into the adjacent brook, causing objectionable pollution of the brook, and, by direction of the Commissioner of Health, an examination of the locality has been made by this Department.

It appears that the sewage of Phillips and Abbott streets is collected at a small reservoir near the junction of those streets and thence pumped automatically into the general sewerage system of the town. The pumping apparatus appears to be unsatisfactory, however, and an overflow has been constructed from the pumping station to cesspools on the north bank of the brook about 1,000 feet southwest of Phillips Street, through which sewage passes to the brook.

An examination of the brook indicates that overflows took place from these cesspools during the period of low flow in the latter part of last year, and the bed of the brook for some distance below the outlet was found to be badly polluted by sewage matters and organic growths usually associated with sewage. In view of the conditions found at this time, it is evident that the stream is likely to be a serious nuisance in dry weather, and it is recommended that provision be made for the proper disposal of this sewage, either by constructing an adequate and efficient pumping station and equipment or by some other plan, early in the coming spring so that further objectionable pollution of this brook shall be prevented before the coming of hot weather.

The Department will be pleased to advise you as to any plan of relief which you may desire to present and will be glad of information as to what action the town decides to take in this matter.

FEB. 25, 1915.

To the Board of Health, Andover, Mass.

GENTLEMEN: — In response to your request of February 20, the Commissioner of Health has considered the need of sewerage in the so-called Abbott Village section of the town of Andover and the report of one of the engineers of the Department upon the conditions existing in this locality.

The results of the examination show that Abbott Village is thickly built up, the number of dwelling houses for a mile of highway being as great as, or greater than, is found in towns in which sewerage systems have already been found necessary. Many of the houses in the district, moreover, are occupied by two or more families, and two or three large boarding houses are included in this section.

So far as the information submitted shows, much difficulty has been experienced in securing proper disposal of sewage by means of vaults and cesspools, and difficulty is caused by the overflow of sewage from cesspools and drains in the midst of this populated district. Furthermore, sewage in considerable quantity from private drains is discharged in one or two places in the neighborhood of the Shawsheen River, whence it finds its way directly into the stream, and there are several privies overhanging the river in the village, a most objectionable method of disposing of sewage under the circumstances.

The results of the examination indicate that the present method of disposing of sewage in this village is a very serious menace to the public health, and it is recommended that steps be taken at the earliest practicable time in the coming year to provide sewers for all of the thickly settled portions of this important district of the town.

Plans for the sewers of this district have already been considered and were approved by this Department in connection with the general sewerage system of the town several years ago, so that the construction of works can be begun as soon as the necessary action is taken by the town.

OCT. 1, 1915.

To the Board of Public Works, Andover, Mass., Mr. FRANK L. COLE, Superintendent.

GENTLEMEN: — In response to your request for an examination of your sewage filter beds and advice as to the necessary extension of the works, the State Department of Health has caused the filter beds to be examined and has considered the results of analyses of the sewage applied and of the effluent therefrom.

The present filter beds have an aggregate area of 3.65 acres. The

filters have recently been improved, the underdrains reconstructed in a large part of the area, and the works are now operated at an average rate of about 60,000 gallons per acre per day. It is necessary, however, in view of the large quantity of sewage to be brought to the works from the Abbott Village and the low level areas, which will probably add at least an average of 60,000 gallons per day to the quantity of sewage now discharged at the works, to provide additional filters for the proper disposal of the sewage.

The condition of the effluent from these filters was very satisfactory in the earlier years, but later on the effluent deteriorated gradually and contained a large quantity of iron and a greater quantity of organic matter than is found in well-filtered sewage effluents. Recently, however, there has been an improvement in the operation of these filters and the quality of the effluent has shown more thorough purification. It will be essential, however, in order to maintain this improvement, to provide an additional filtration area, and a further addition should be made to provide for the additional quantity of sewage to be discharged at the works. In the opinion of the Department, an addition of at least $1\frac{1}{2}$ acres should be made immediately and a further addition during the next season sufficient to increase the area to as much as 6 acres. The additions should also include provision for extra sludge drying beds, the area available for that purpose at the present time being less than half the amount required.

When plans for the additional works have been prepared, the Department will be pleased to advise you concerning them and also to examine samples of the material which you propose to use, if you so request.

BEVERLY.

JUNE 29, 1915.

TO HON. HERMAN A. MACDONALD, *Mayor of Beverly, Mass.*

DEAR SIR:—Several years ago a petition was presented to this Department by the city of Beverly requesting its advice relative to certain proposed plans for intercepting and outfall sewers for the city of Beverly designed to divert the sewage from the present sewer outlets of the city to a point in the sea near Great Haste Island. Action on these plans was postponed from time to time by the Department at the request of the city authorities, the last suggestion for postponement stating that, on account of the importance of the undertaking, sufficient time should be allowed for consideration of the matter by the public and inviting a recommendation by this Department.

In the meantime, the city has grown and the objectionable condi-

tions due to the discharge of sewage at the main outlet have increased materially as compared with the conditions at the time the petition was presented. The sewage is discharged not far from the shore in such quantity that, under certain conditions, floating matters from the sewage are deposited upon the beach to the east of the outlet which is used by large numbers of people in the summer season. These conditions are a serious menace to the health of the city, and it is important that some relief be provided or the objectionable conditions will grow worse as the city grows, and with increased use of this beach it is very desirable that the city shall remove its sewage from the present main sewer outlet at the earliest practicable time.

It happens that at the present time the town of Danvers also has the question of sewerage under consideration, and one of the methods of disposal presented by their engineers for the consideration of that town is a plan for discharging the sewage of the town into the sea, providing a joint arrangement can be made with the city of Beverly. There would no doubt be considerable economy for both Danvers and Beverly if an arrangement could be made whereby the same outfall sewer and outlet could be used by both, and, in the opinion of the State Department of Health, it is advisable that Beverly and Danvers should consider jointly the practicability of disposing of their sewage by a joint plan.

If such a plan is found impracticable, however, the city of Beverly should, in the opinion of the Department, proceed with plans for removing its sewage from the present main outlet to some suitable place of disposal at the earliest practicable time.

BRIDGEWATER.

APRIL 3, 1915.

To the Board of Health, Bridgewater, Mass.

GENTLEMEN:—The State Department of Health has considered your further request for advice relative to the disposal of the sewage of the town in accordance with the plans submitted in the early part of 1914 and has also considered the probable effect of the discharge of sewage into the Town River at a point close to the village of Bridgewater and at other points farther down the river.

The flow of the Town River where it passes the village of Bridgewater is very small in dry summer seasons. It is materially increased no doubt by the effluent from the sewage disposal works of the city of Brockton, but even with this increase of flow it is unlikely that the river could receive unpurified sewage from any considerable por-

tion of the village without becoming a nuisance. The district from which you propose to collect the sewage at the present time includes only a comparatively small section of the main village, the sewage from some portions of which already enters the stream, and if the sewage from this small section should be discharged into the river after thorough sedimentation it might not create seriously objectionable conditions in the stream within the next two or three years.

The circumstances are such, however, that the use of the river for sewage disposal at the point proposed, even for the short period during which it might perhaps be used without objection so far as the condition of the river immediately below it is concerned, would be a violation of the provisions of existing laws.

The Bridgewater Water Company owns wells on the banks of the river which have been used until recently and may again be used for the water supply of the town, and water is also drawn from the river for certain purposes by the State Farm at Bridgewater and may be used for drinking by the inhabitants of that institution. The discharge of sewage into a river on whose banks such works are located is prohibited under the provisions of chapter 75, section 124, of the Revised Laws which is as follows:—

SECTION 124. No sewage, drainage, refuse or polluting matter, of such kind and amount as either by itself or in connection with other matter will corrupt or impair the quality of the water of any pond or stream used as a source of ice or water supply by a city, town, public institution or water company for domestic use, or render it injurious to health, and no human excrement, shall be discharged into any such stream or pond, or upon their banks if any filter basin so used is there situated, or into any feeders of such pond or stream within twenty miles above the point where such supply is taken.

In view of the provisions of this law, it seems to the Department that the discharge of sewage into the Town River, or even into the Taunton River in the neighborhood of the village of Bridgewater, is not permissible unless treated to such an extent that the effluent will not corrupt or impair the water of the stream into which it is discharged, and this Department cannot advise the discharge of sewage from Bridgewater into any stream in the neighborhood of the village unless it has been purified to such an extent as in the opinion of the Department will comply with the statute quoted above.

Furthermore, experience shows that when a sewerage system is introduced into a town its advantages are rapidly extended throughout the thickly settled section, and such would no doubt be the case in the town of Bridgewater. It is very probable that, if sewage from

the town were discharged into the river as proposed through a system controlled by the town, an efficient purification of the sewage would become necessary in any case within a very short time.

In view of the circumstances, it is recommended that investigations be made and plans prepared for works for the treatment of the sewage to such an extent as will secure compliance with the existing law. In selecting a location for the disposal works, it is important to secure, if practicable, a location where the conditions are such that the works can be enlarged when necessary to provide adequately for the future treatment of all of the sewage of the town so far as can now be foreseen. The Department will assist you in further investigations for the disposal of the sewage, if you so request, by making the necessary examinations of proposed locations and of soils which may be suggested for the disposal of the sewage, and will give you further advice in the matter of the disposal of the sewage of the town when you have the results of these investigations to present.

BROCKTON (BROCKTON GAS LIGHT COMPANY).

To the Brockton Gas Light Company, Brockton, Mass.

DEC. 16, 1915.

GENTLEMEN:—The State Department of Health has considered your application for an investigation of the method of disposing of the wastes from your works at Brockton and advice relative thereto and has caused the locality to be examined and samples of the wastes to be analyzed.

It appears from the examination that the wastes discharged from the manufacture of water gas are of an oily and tarry nature, highly colored, and usually give off a rather strong gas works odor. Measurements of the wastes on different days during the past few weeks show that the waste from the water-gas plant amounts to about 7,500 gallons per day and that discharged from the relief holder to about 5,400 gallons per day. In addition to these wastes a small quantity of waste from the ammonia purifier is discharged into a cesspool which is about 15 feet in diameter and 20 feet in depth. This cesspool is located about 25 feet from the Vinegar Swamp drain. The general wastes from the water-gas plant are discharged into a concrete tank 10 feet by 8 feet in plan and 3 feet 8½ inches deep, having a capacity of about 2,200 gallons, whence they flow upwards through two filter or strainer cribs, so called, said to contain one layer of coke breeze and two layers of sand, each layer having an area of about 43 square feet and a thickness of 3 to 5 inches, the effluent from which is discharged into the Vinegar Swamp drain.

With the quantity of waste being discharged from the water-gas plant at the time the measurements were made, the rate of operation of the filters was about 7,700,000 gallons per acre per day. Very little suspended matter is removed from this waste in its passage through the tank and filters.

The waste from the relief holder is discharged through a similar tank and filter, the tank having a capacity of about 1,400 gallons and each of the three layers of the filter an area of about 82 square feet. Judging from the measurements of the quantity of this waste, the rate of operation of this filter at the time of the examination was about 2,900,000 gallons per acre per day. The effluent, which contains more ammonia than that from the water-gas plant, is discharged with that effluent into the Vinegar Swamp drain.

A comparison of the analyses of the Vinegar Swamp drain above and below the gas works indicates that the effluents discharged from the works into the drain increase the pollution of the water, and a comparison of the analyses of Salisbury Plain River above and below the outlet of the drain indicates that the wastes discharged into the river from the drain increase somewhat the pollution of the river, though there has been an improvement in the condition of the river during the past year as compared with earlier years.

The results of these examinations indicate that a more efficient purification of the wastes discharged from your works is desirable and can probably be effected without great difficulty. Studies of these and similar wastes by the chemist of this Department show that, by treating the wastes with lime in a precipitation tank and subsequently filtering them through a sand filter of adequate size, they can be discharged into the Vinegar Swamp drain and the Salisbury Plain River without objection.

The Department recommends that the wastes be collected into a sedimentation tank of much larger size than the tanks now in use and that lime be applied to the wastes in this tank in the proportion of 2 to 3 pounds per thousand gallons of wastes. A tank in two compartments, each holding 3,000 gallons, would be sufficient for the purpose while the quantity of wastes remains as at the time of the examination. If the depth of the wastes in the tank were 4 feet, the total area of this tank would be 10 feet by 20 feet. With two compartments with a baffle board and weir between, an adequate period of sedimentation will be secured. The tanks should of course be so designed that the sediment can be removed from them at frequent intervals. The total quantity of lime required for the treatment of the wastes if the quantity is about the same as that indicated by the

recent measurements would be about 35 pounds per day. The effluent from this tank should be discharged upon a sand filter operated at a rate no greater than 500,000 gallons per acre per day. With the present quantity of wastes, that rate would require a filter having an area of 1,100 square feet. It should be constructed of fine gravel or coarse sand, with a depth of at least 3 feet of filtering material with suitable underdrains.

In the opinion of the Department, if the wastes are treated with lime in suitable tanks as herein suggested and subsequently filtered through sand filters at the rate indicated, the effluent can be discharged into the Vinegar Swamp drain and the Salisbury Plain River without objection.

CANTON (SPRINGDALE FINISHING COMPANY).

FEB. 13, 1915.

To the Springdale Finishing Company, Canton, Mass.

GENTLEMEN: — The Commissioner of Health received from you, through your counsel, Henry F. Buswell, Esq., on Nov. 2, 1914, the following communication requesting advice relative to the chemical treatment of the wastes from your factory at Canton:

By direction of my client, the Springdale Finishing Co., of Canton, I have to state to you the experiments which the Company has been making in the chemical treatment of wastes resulting from the operation of its factory, with the view of lessening, or wholly removing the offensive odor of such wastes.

(1) The liquid holding the wastes in suspension has been treated with copper sulphate (blue-stone) and sodium bi-chromate, with the result of very materially lessening, but not wholly removing, the offensive quality of the wastes.

(2) For several weeks, the organic matter remaining after treatment (1) was treated with calcium oxychloride. The result of this treatment was not satisfactory.

(3) The wastes consist of organic matter, in suspension, mostly sulphides, which, in the course of evaporation, give out offensive hydrogen sulphide. For the last three weeks, as the liquid enters the catch-basins, it has been treated with ferrous sulphate, producing a black precipitate of iron sulphide. It is too early, as yet, to make sure of this treatment; but, so far, it promises excellent results.

(4) We intend to try, further, a treatment with aluminum sulphate, should treatment (3) prove not entirely satisfactory.

My client would be obliged for any suggestions which the State Board of Health may be able to make in the matter of the chemical treatment of offensive wastes. It seems obvious that such treatment, if satisfactory, must afford the surest means of effecting the desired result.

In response to this application, the Commissioner has caused further studies to be made at your works and at the Lawrence Experiment Station of the purification of the wastes from this factory, the results of which confirm those of previous investigations. They show that these wastes as examined recently are practically of the same character as in former years, varying in color from yellowish to nearly black, and that they pollute very seriously the tributary of the Neponset River into which they are discharged.

The investigations further show that when these wastes are treated with lime in the proportion of 5,000 pounds per million gallons, about 40 per cent. of the organic matter is removed and that when filtered through sand a clear, slightly colored, non-putrescible effluent comparatively low in organic matter is obtained. Filtration can be carried on at a higher rate by using the preliminary treatment with lime than if this treatment is omitted, or, in other words, the area of filters required for the purification of the wastes will be less if the lime treatment is used than if the waste is discharged upon the filters without such preliminary treatment.

The question of the use of various precipitants in the treatment of these wastes has been very thoroughly studied at the Lawrence Experiment Station in connection with the treatment of numerous other manufacturing wastes from factories in all parts of the State for many years, and the results of these experiments have been published from time to time in the annual reports of the Department, especially in the report for 1909.

It does not appear to be necessary for you to make further studies such as outlined in your counsel's letter, and such further studies would operate to delay the construction of works for the proper treatment of these wastes.

It is recommended that you begin at the earliest practicable time the construction of works for the proper purification of these wastes. The department has already advised you, under date of May 11, 1914, as to the character of the works in its opinion necessary for the proper treatment of these wastes. Unless the construction of works for the proper treatment of these wastes is begun in the early spring, it will be my duty to present the facts to the Public Health Council for such action as they may deem desirable in the circumstances.

DANVERS.

JUNE 29, 1915.

To the Sewer Committee, Danvers, Mass., Mr. LESTER S. COUCH, Clerk.

GENTLEMEN: — The State Department of Health received from you on May 29, 1915, the following application for advice with reference to a proposed system of sewerage and sewage disposal for the town of Danvers.

We herewith present the plan for a proposed sewerage system for the Town of Danvers, Mass., together with the report of our engineers, Messrs. McClintock & Woodfall, and respectfully request that your Board examine and take such action as is necessary under the law, and report your findings to our Board.

The application was accompanied by a report of your engineers, Messrs. McClintock & Woodfall, outlining the results of investigations as to the collection and disposal of the sewage, together with a plan showing the proposed system for the collection of the sewage of the town. These investigations have included studies of various methods of sewage disposal, and detailed information is presented concerning three of these methods: — (1) the disposal of the sewage by intermittent filtration upon land in the extreme northerly part of the town; (2) the treatment of the sewage by trickling filters located southwest of Folly Hill; (3) the disposal of the sewage into the sea either jointly through the sewerage system of the city of Beverly or through a joint outlet, which may be used also by the city of Beverly, through which the sewage would be conveyed to an outlet in deep water southeast of Great Haste Island. The investigations have shown that, by any of the plans considered, pumping of the sewage would be necessary, and the design of the collecting system has included the selection of a location for a pumping station adapted for use with any of the systems of disposal that may ultimately be adopted.

The Commissioner of Health has caused an examination of the proposed location of the sewerage system and of the various disposal works to be made by the engineer of the Department and has considered the plan and report submitted therewith.

The town of Danvers with one exception is the largest in the State unprovided with a system of public sewers, and the local waters are very badly polluted by sewage from private sewerage systems, and especially by wastes from the various tanneries and other manufacturing industries in the town. These pollutions are such as to cause very serious nuisances at several points in the neighborhood of the

town and to cause also seriously objectionable conditions in the Danvers River, where great areas of flats are exposed at low tide. These flats are becoming increasingly polluted with sewage, and very offensive conditions are likely to result unless the sewage and objectionable manufacturing wastes are removed from the waters about the town to a proper place of disposal.

The results of the studies for a system of sewers capable of serving all the thickly settled parts of the town show that, while the collection of all of the sewage by gravity at one point involves considerable difficulty on account of the character of the topography of the town, it is practicable, by means of main sewers in the different valleys, to collect all of the sewage at a point near Porter River just east of Liberty Street, from which the sewage can be pumped conveniently either to disposal works on land or to an outlet into the sea.

An examination of the various areas found to be available for the purification of the sewage by intermittent filtration shows that the area best suited for the purpose, both in location and character of soil, is the tract known as the Connor Farm in the extreme northerly part of the town. This area is located in a sparsely inhabited region, and the soil over a large portion of it is of excellent quality for the purification of sewage by intermittent filtration. The contour of the land is well adapted for the economical construction of filter beds, and an ample area is available to serve the town for many years in the future. The cost of conveying the sewage to this point is considerable, however, on account of its elevation and distance from the town, and the discharge of the effluent into the very small stream that passes near this area might be objectionable, and it might be necessary to convey the effluent from the filters in a pipe to the Ipswich River. It is practicable, however, to dispose of all of the sewage of the town at this place for many years in the future at a cost which is not excessive as compared with the cost of the disposal of the sewage at other places in the State, where the quantity of sewage requiring disposal is similar to that which is likely to be collected by a general system of sewerage in the town of Danvers.

The second method of sewage disposal considered by your engineers provides for the filtration of the sewage through trickling filters to be constructed near the southwesterly base of Folly Hill in the extreme easterly part of the town. These filters would be constructed of broken stone and the sewage would be discharged upon them at frequent intervals in the form of spray. The plans submitted provide for the construction of half an acre of filters with a depth of 7 feet, with preliminary settling tanks for the treatment of the sewage, secondary

settling tanks for the settling of the effluent from the trickling filters, which would contain a large quantity of suspended matter, and a 16-inch cast-iron pipe to convey the effluent from the secondary settling tanks to the Danvers River. The latter pipe would also be utilized to convey the sludge to a tank boat, in which it would be transported to a point of discharge into the sea.

The location selected for these works near the base of Folly Hill appears to be a convenient one for the purpose and, with suitable works properly operated, it will be practicable to treat the sewage at this place without creating objectionable conditions in the neighborhood.

The third plan of disposing of the sewage considered by the engineers provides for discharging it into the sea at a point southeast of and not far from Great Haste Island where the depth of water at low tide is 35 feet. Two plans are considered by your engineers, one providing for a sewer, force main and outlet to be used jointly by the town of Danvers and city of Beverly, and the other providing for a joint outlet pipe only from the shore of Beverly Harbor near the present outlet of the Beverly sewer to the proposed point of discharge near Great Haste Island.

The present sewer outlet of the city of Beverly is located in the immediate neighborhood of the shores of Beverly Harbor, and the discharge of the increasing quantities of sewage through that outlet has become seriously objectionable, and a new outlet for the sewage is under consideration by that city. If Danvers and Beverly should make a joint arrangement for the disposal of their sewage through a single outfall pipe, there is no doubt that a material saving in the cost of disposing of the sewage of both municipalities could be effected. The estimates of cost of works submitted by your engineers indicate that the first cost of a sea outlet would be greater than that of any of the other methods considered, but the cost of maintenance of a sea outlet would be much less than the maintenance of filtration works. Bringing all the estimates together and making due allowance for interest, bond payments and maintenance of works, the annual cost of a sea outlet would probably be greater than that of disposing of the sewage at Folly Hill, though less than that of purifying the sewage by intermittent filtration at the Connor Farm.

There is little doubt that very material enlargements in works for the purification of the sewage within the limits of the town would be necessary from time to time in the future, and it is probable, under the circumstances, that an outlet into the sea, provided a satisfactory arrangement could be made with the city of Beverly, would be less

expensive than any method by which the sewage could be disposed of upon land within the town.

In view of all the circumstances, it is the opinion of the State Department of Health that the best practicable and most economical method of disposing of the sewage of the town of Danvers will be to discharge it into the sea in connection with the sewage of the city of Beverly, provided a satisfactory arrangement for a joint outlet can be made with that city.

Inasmuch as legislation will no doubt be necessary in order to enable the municipalities to act jointly in this matter of sewage disposal or to authorize either of them to dispose of its sewage into the sea, it is important that the question of joint action be considered in the near future so that such legislation as may be deemed desirable may be secured at the next session of the Legislature.

If it is not found practicable for the town of Danvers to dispose of the sewage into the sea, the plan of treating it on trickling filters near Folly Hill appears to be the most desirable, under the circumstances, for the town to adopt.

DANVERS (DANVERS LEATHER COMPANY).

MARCH 13, 1915.

To the Board of Health, Danvers, Mass., E. H. NILES, M.D., Chairman.

GENTLEMEN: — Since receiving your request for an investigation of the offensive odors said to be caused by a drain running from the factory of the Danvers Leather Company along the property of the Boston & Maine Railroad to a meadow in the vicinity of the Bay State Street Railway Company's car barns, which were found to be a nuisance, the Commissioner of Health has caused the character of the discharge from the factory of the Danvers Leather Company to be examined and has caused experiments to be made to determine a practicable method of treating this waste in such a way as to prevent further objections after its discharge into the drain.

The total quantity of water being used in this factory at the time of these investigations was a little less than 100,000 gallons per day, and the total quantity of manufacturing waste about 83,000 gallons per day. The sewage from the factory is kept separate from the manufacturing waste and is disposed of in a cesspool. The stock at this factory which consists of scrap leather, paper, jute, etc., is treated in machines similar to those employed in paper mills, and the manufacturing waste consists almost wholly of the waste water from the machines. This waste at the time of the examination was being passed

through two trenches and four settling basins and subsequently discharged into an open trench terminating in a swamp about 2,400 feet from the factory. The treatment was designed to retain as much as possible of the matters in suspension in the waste and prevent them from entering the drain. The treatment of the waste by sedimentation alone, however, is not as efficient as desirable in order to prevent objectionable conditions in the drain. The experiments that have been made with this waste, however, show that it is apparently very easily clarified and rendered inoffensive by chemical precipitation with aluminum sulphate applied at the rate of 2,000 pounds per million gallons. By treating the waste with this substance in suitable tanks, a very large portion, probably 90 per cent., of the organic matter is removed and an inoffensive, straw-colored effluent is obtained which is stable, as shown by laboratory tests.

There is ample space in the yard for the construction of settling tanks of proper capacity to allow the treatment of the wastes with aluminum sulphate. By providing for this treatment with tanks of suitable design, it is probable that the waste liquid could be allowed to flow from the factory into the drain without creating objectionable conditions. It will be necessary to design the tanks so that they can be cleaned readily from time to time and to provide for the disposal of the sludge at some suitable place.

JUNE 9, 1915.

To the Danvers Leather Company, Danvers, Mass.

GENTLEMEN: — In reply to your request of April 23, 1915, for advice with reference to the efficiency of the save-all through which your wastes are passed before discharging them into the drain from which they find an outlet to a tributary of the Danvers River, the Commissioner of Health has caused the locality to be examined and samples of your wastes before and after passage through the save-all to be analyzed.

It appears that the system of sedimentation formerly in use at this factory has been discontinued for the present and the wastes are treated only by passage through the save-all. The analyses show that there is practically no change in the condition of the wastes as a result of the use of the save-all, and the wastes discharged to the final outlet are little, if any, improved by its use. The reason for this is that the wastes contain little or no fiber and the suspended matters are light and flocculent. The wastes, as you have already been advised, can be efficiently treated by chemical precipitation in suitable tanks using alum as a precipitant, the quantity of alum required being about

2,000 pounds per million gallons, which would be equivalent to about 166 pounds per day for a quantity of effluent amounting to 83,000 gallons per day, which was the amount being discharged from the factory at the time of the last examination.

It is recommended that works for the efficient treatment of the waste be constructed at the earliest practicable time.

DEERFIELD (SOUTH DEERFIELD).

OCT. 21, 1915.

To the Board of Selectmen, Deerfield, Mass.

GENTLEMEN: — The State Department of Health has considered your application for advice as to the disposal of sewage from the two hotels at South Deerfield and the plan submitted therewith and has caused the locality to be examined by its engineer.

The plan provides for the construction of a sewer designed primarily for the removal of sewage from the Lathrop Hotel and the Hotel Warren, located at or near the junction of Elm, Main and Sugarloaf streets, and for conveying it to a tank, designated as a catch basin on the plan, to be constructed on the westerly side of Sugarloaf Brook about 100 feet south of Sugarloaf Street. This catch basin, as shown on the plan, is to be 16 feet square, with its nearest side about 3 or 4 feet from the edge of the brook, and is to be provided with an overflow pipe 25 feet in length laid with open joints parallel to and at a distance of about 10 feet from the brook.

It would be advisable, in the opinion of the Department, to modify this plan of disposal by constructing, instead of the catch basin, two cesspools 6, or if practicable 8, feet in diameter and so arranged as to provide a depth of 4, or possibly 5, feet of liquid, and to construct an overflow pipe from the second cesspool discharging into a small sub-surface filter to be located farther down stream. The sub-surface filter could best be constructed by excavating the material over an area of about 25 feet in length and 10 feet in width bordering the brook to a depth of about 3 feet and filling this area to the level of the original surface of the ground with coarse sand or gravel suitable for the filtration of sewage. The sewage should be discharged into this filter through a pipe connected with the overflow pipe from the second cesspool and laid longitudinally along the inner edge of the filter farthest from the stream, with its joints open and the top of the pipe at a depth of about one foot below the finished surface.

The works herein suggested will probably operate satisfactorily for a time in disposing of the sewage of the hotels and preventing the

serious pollution of the brook, but they provide at best only a temporary method of disposing of this sewage. It will probably be necessary occasionally to clean out the first cesspool and perhaps also the second cesspool, and it will probably also be found necessary from time to time to dig up, clean and relay the pipe laid along the edge of the filter bed.

The present conditions in the village of South Deerfield as regards the disposal of sewage are very objectionable, and there are indications that Sugarloaf Brook is seriously polluted by sewage from other sources than the hotels in question. A proper system of sewerage is very greatly needed in this village, and as the village is so situated that a gravity outlet for the sewage into the Connecticut River can very probably be secured, the construction of a sewerage system would not be difficult nor its cost a serious burden upon the town, since under existing laws much of the cost would necessarily be assessed upon the estates benefited by the sewers.

The Department recommends that your board take such action as will secure the preparation of the necessary plans for sewerage and the installation of such a system at the earliest practicable time. The Department will be pleased to advise you as to any plan or plans of sewerage that you may desire to present as soon as the results of a careful investigation of the subject are available.

DRACUT (AMERICAN WOOLEN COMPANY).

OCT, 14, 1915.

*To the American Woolen Company, Lawrence, Mass., Mr. WILLIAM S. WHITNEY,
Supervising Engineer.*

GENTLEMEN: — In response to your request of Sept. 27, 1915, for an examination of the sand in the filter beds at the Beaver Brook Mills in the village of Collinsville, in the town of Dracut, and advice as to the removal of the material from the surfaces of these filters, the State Department of Health has caused the filters to be examined and samples of the sand and also of the applied wastes and effluent from the filters to be analyzed.

The results of the examinations show that at this time only two of the six filter beds available for the disposal of wastes at this mill were free from flooding, and samples of sand have been collected at various depths from these two filters. Examinations have also shown that the sand at the surfaces of these filters has become badly clogged to a depth of at least 6 inches and that it contains an excessive quantity of organic matter and a very considerable quantity of fats. In the

opinion of this Department, it is essential that the clogged sand at the surfaces of these filters be removed and an equal depth of clean sand of suitable quality be provided in its place. Judging from the filters examined, it is not difficult to determine the depth to which clogging has extended in these filters, and it is important that when the improvement is made all of the sand containing organic matter, that is the sand showing discoloration, shall be removed. When the new sand is applied, the work should be done under competent engineering supervision in order that there may be no stratification between the surface of the old sand and the new layer.

The information available to the Department shows that at the time these filters were constructed the quantity of wastes discharged from this mill amounted to about 400,000 gallons per day, while information as to the quantity of wastes at present discharged from these works indicates that the amount is much greater than formerly, probably as great as 700,000 gallons per day. Furthermore, the quantity of organic matter contained in the raw wastes applied to these filters at the present time is considerably greater than was the case at the time the filters were first used.

Under the circumstances, it is obvious that these filters are of inadequate area to provide properly for the purification of the quantity of wastes at present discharged from this mill, and it is essential, in order to secure their proper purification, that an additional area of filters amounting to at least $3\frac{1}{2}$ acres shall be made available at the earliest practicable time. It is also very desirable that the suggestions made by your department as to lengthening the openings between the settling tanks be carried out in order to reduce the velocity of flow near these openings and improve the sedimentation of these wastes. Your further suggestion as to the screening of these wastes is a very desirable one to adopt since experience has shown that by screening and sedimentation a very considerable quantity of organic matter can be removed from these wastes before they are carried to the filters.

An examination of the underdrains in the northerly filter shows at the present time little evidence of clogging, but with the application of excessive quantities of wastes to the filters there is danger that the underdrains will eventually become clogged.

It is recommended that the improvement of the filters and the other changes herein suggested be carried out at the earliest practicable time in order that serious danger of further injury to the present filters may be avoided.

EDGARTOWN (NORTH SCHOOL).

MAY 8, 1915.

TO MR. FRANK W. SAUNDERS, *State Inspector of Buildings, New Bedford, Mass.*

DEAR SIR: — In response to your request for advice as to the practicability of disposing of the sewage of the North School, so called, in Edgartown, by means of cesspools, the Commissioner of Health has caused the location of the proposed school to be examined and has considered the information presented.

The elevation of the ground water in the school yard is about 9.2 feet below the surface of the ground at the present time, and the level of the ground water appears to be much the same over a considerable area in the vicinity of the school. The elevation of the floor of the compartment to be used for water closets is about 5.3 feet above the present level of the ground water.

At the time of this examination, however, the elevation of the ground water was undoubtedly abnormally low, and there are indications that at other times the ground water rises to a level within 3.5 feet of the level of the floor on which the water closets are to be located. The discharge of the sewage from the water closets into the ground would, moreover, have a tendency to raise still further the ground water level. Under ordinary conditions, the ground water level would probably not rise sufficiently to reach the level of the basement, but it is not certain that at periods of high rainfall the ground water level would not rise to such a height as to interfere with the proper disposal of the sewage. By distributing the sewage from two or more cesspools with radiating pipes, it would be distributed over a wider area and a material raising of the ground water level might thus be avoided. While this plan might not operate satisfactorily, the circumstances are such that there appears to be no better way at present of providing for the disposal of the sewage of this school. If the building could be raised somewhat, the probability of the success of the plan would be increased. If it is not practicable to raise the building and if objectionable conditions result from any rise in the ground water level, it may be necessary to provide for lowering the level of the ground water by means of a drain laid to an outlet into tide water.

In view of the circumstances, it is recommended that the level of the water closets be raised as much as practicable and the sewage spread over as wide an area as can be made available. If trouble should be experienced in the disposal of the sewage it will be neces-

sary either to lower the level of the ground water by means of a drain to tide water or to provide a sewer to convey the sewage to some point where it can be disposed of without objection.

FALL RIVER.

MARCH 24, 1915.

To the Watuppa Water Board, Fall River, Mass., Mr. R. F. HAFFENREFFER, JR., President.

GENTLEMEN: — The Commissioner of Health received from you, through your consulting engineer, on Feb. 18, 1915, the following application for advice relative to a proposed plan for disposing of the sewage and wastes at the Fall River water works pumping station:

By direction of Mr. R. F. Haffenreffer, Jr., President of the Watuppa Water Board, Fall River, Mass., I am sending you herewith a copy of my report and accompanying plan upon the matter of sewage disposal at the Fall River Pumping Station.

It is the desire of the Watuppa Water Board that your department review the plan and recommendation made in the report and if satisfactory approve the same or make such comments thereon as seem desirable.

The application states that there are in and about the pumping stations at the present time from 15 to 20 persons, including the family of the chief engineer, and that it is not expected that the number will exceed 25 persons for many years to come. Allowing 50 gallons of sewage per capita, the total amount of sewage to be disposed of is estimated to be 1,250 gallons per day.

Two schemes are presented for the disposal of the sewage, by one of which the sewage is to be collected in a steel tank 3 feet in diameter and 7 feet deep, to be located in the basement of the main pumping station. From this tank the sewage is to be pumped by an ejector, arranged for automatic operation, to a sand filter bed to be located about 200 feet from the main pumping station. The filter bed is to be 25 feet in diameter with an average depth of $3\frac{1}{2}$ feet of sand, and the effluent is to be discharged into the proposed intercepting drain now being constructed along the westerly shore of North Watuppa Pond. The total cost of this scheme is estimated at \$1,830.

The second plan provides for collecting the sewage in a tank as above, whence it will be pumped through a force main to the top of the Bedford Street hill, where the sewage will be discharged into an 8-inch vitrified sewer, to be constructed in Bedford Street to a connection with an existing sewer at Eastern Avenue. The estimated

cost of this plan is \$3,910. The latter figure includes, however, the vitrified pipe sewer in Bedford Street costing about \$1,100, which will eventually be useful for the sewerage of this street.

The report also mentions certain other wastes requiring disposal at the pumping station, viz., (1) water blown from the boilers, (2) condenser water from the pumps, and (3) a small amount of oily waste. It is proposed to discharge the water blown off from the boilers into the intercepting drain, and the condenser water from the pumps, after passing through certain oil traps, is also to be discharged into the intercepting drain. It is proposed to dispose of the oily waste, said to be small in amount and collected in a tank in the basement, into the ash heap in the rear of the building, while the sink waste is to be discharged into the intercepting drain.

The Commissioner of Health has caused the plan to be examined and has considered the information presented. The estimate of the quantity of sewage does not appear to be excessive and, in view of the desirability of disposing of sink wastes in connection with the sewage, it is likely that the quantity indicated may represent the average quantity of sewage requiring disposal continuously. With the size of the filter proposed, the rate of filtration would be about 111,000 gallons per acre per day, and with such a rate, even with the most efficient care, there might be trouble in the operation of the filter.

Considering the circumstances, it is advisable that the area of the filter be made at least as much as twice as great as proposed, and it may be found desirable to enlarge the area still further at no distant time in the future.

In view of the probability that the proposed sewer in Bedford Street under the second plan would be useful for the sewerage of this street at no distant time, the difference in cost of the two plans suggested is not likely to be considerable. It would be preferable to avoid if possible the location of a sewage filter bed in the immediate neighborhood of your pumping station, and while the discharge of the effluent, if thoroughly purified at all times, into the intercepting drain would be permissible, this effluent will contain a large quantity of nitrates which would tend to maintain growths of organisms in the uncovered parts of the conduit and in the water of the South Pond in the neighborhood of the outlet.

Considering all of the conditions, the Commissioner of Health is of the opinion that the discharge of the sewage into the Bedford Street sewer is the most efficient and satisfactory method of disposal to adopt. It is recommended that in providing for the disposal of the sewage by this plan, provision be made for discharging all of the sew-

age, including that from sinks and bath tubs, into the Bedford Street sewer. The water blown off from the boilers is unpolluted, and its discharge into the intercepting drain appears to be an unobjectionable method of disposal for this waste. The condenser water, if freed from oil, can also be discharged into the intercepting conduit without objection. The remaining small amount of oily waste, together with oil separated from the condenser water, should be disposed of in some suitable way where it will not affect either the water of the pond or the conduit. The oil should in any case of course be kept out of the sewage.

FOXBOROUGH.

FEB. 24, 1915.

To the Board of Selectmen, Foxborough, Mass.

GENTLEMEN: — The State Department of Health has received from you the following application for the approval of certain plans of sewage disposal in Foxborough:

Will you consider the plans for sewage disposal on land North of Elm St. and Easterly of N. Y., N. H. & H. R.R. in Foxboro, to be submitted by J. J. Van Valkenburgh, C. E., and advise us if you will approve the same. . . .

The plan submitted with the application shows a proposed sewer extending northeasterly in Leonard Street from your present sewer to a point on the easterly side of the New York, New Haven & Hartford Railroad, thence in a generally southerly direction in lands now owned, or the taking of which has been approved by this Department, to filter beds which it is proposed to construct on the northerly side of Elm Street from 300 to 700 feet east of the New York, New Haven & Hartford Railroad. It is proposed to use these works for the purification of the sewage from the present main sewer and such additional sewage as may be discharged into the sewers of the town in the future until such time as the quantity of sewage shall equal the capacity of the filters indicated on the plan, which is estimated by your engineer to be about 180,000 gallons per day.

In response to this application, the Public Health Council gave a hearing at its office, Room 143, State House, on Jan. 26, 1915, after notice by publication in newspapers circulating in Foxborough and notice to the authorities of the town of Mansfield. At this hearing objection was made by the authorities of Mansfield to the establishment of filters in the location proposed chiefly on account of the small size of the brook into which the effluent would discharge and the fear that this stream might be permanently polluted, thus in-

creasing the already objectionable conditions in the central portion of Mansfield due to the discharge of sewage and waste from that town into these ponds. It was stated that the town of Mansfield has already under consideration plans for the construction of a system of sewerage to remove objectionable conditions from the waters within its limits and desires to avoid any danger of objectionable pollution of any stream which enters the ponds in the thickly settled portion of the town.

Plans for the disposal of the sewage of Foxborough have been under consideration by the town for several years, and this Department has considered plans both for the temporary disposal of the sewage flowing from the present sewer of the town of Foxborough upon land near Elm Street and a general plan for the disposal of all of the sewage of the town upon an area near South Street mentioned at the hearing. In the latter case the effluent would enter the Wading River, which flows through the westerly part of Foxborough and Mansfield ultimately into the Taunton River.

The taking of the lands near Elm Street for the temporary disposal of the sewage then being discharged from the sewer of the town of Foxborough was approved by the State Board of Health on May 1, 1913, after a hearing. Subsequently on May 14, 1914, a sewerage committee of the town of Foxborough submitted the following application for further advice relative to the disposal of the sewage of the town:

Having been appointed by the Town of Foxborough, a Committee to bring in at a special town meeting before June 1st necessary votes for action upon the sewerage disposal plan of Mr. J. J. VanValkenburgh of 1908 (Near Elm St.) we have, after investigating, not been able to convince ourselves that to adopt that plan, would not be short sighted and ultimately most expensive and unsatisfactory. We understand you approved the plan near Elm Street for a temporary proposition, and later as developed to attempt to make it more permanent.

Anxious to get all possible light on the subject for ourselves, and to assist us in convincing others, we should be pleased if you would advise us your best judgment on the following:

1. Would you approve such plans now?
2. The least that can be done, taking present drain and caring for it alone, near Elm St. is estimated to cost \$13,000.00. Would this not be wasteful expenditure and short sighted, with an adequate disposal site at South Street permitting an all gravity system, and enabling at an estimated expense of \$60,000.00 — serving all the central and Eastern part of the town and the State Hospital?
3. The Elm Street disposal, being located as it is, so very near to the line of traffic — R. R., Trolley and Main Highway — the latter having electric light

and water to the Mansfield line, would it not soon become objectionable and tend to prevent growth in this direction?

4. If Elm Street should be adopted, how many years before the probabilities are that a change to such as the South Street disposal would be desirable or compulsory?

We should be pleased to have your reply before May 20th if possible.

The State Board of Health on May 22, 1914, after replying to certain specific questions, made the following recommendation:

. . . In conclusion, the Board urges such action in the matter of sewerage in Foxborough as will prevent without further delay the objectionable conditions resulting from the very serious pollution of the west branch of the Rumford River by the sewage now discharged south of Leonard Street. This nuisance can be prevented by disposing of this sewage on filter beds near Elm Street but, so far as the Board can now judge, there seems to be no doubt that the most economical and desirable plan for the town of Foxborough to adopt in the beginning will be the plan which provides for the disposal of all of the sewage of the town upon the South Street area, thus allowing for the gradual extension of the sewerage system throughout the village. . . .

A full copy of this reply is appended.

It appears that there is a demand for the extension of sewerage in the village of Foxborough and that it is desirable that sewers be extended there as soon as practicable, and if works should be constructed for the temporary disposal of the sewage of the present sewer and the use of the present sewer were restricted to the connections which have thus far been made therewith, the plan might operate to delay the necessary extension of sewerage facilities in other parts of the village. If, on the other hand, additional connections were made with the present system, the quantity of sewage requiring disposal in the valley of this brook near Elm Street would increase in the future.

After further consideration of the plans and information presented to the Public Health Council, and in view of the representations made at the hearing, it appears to the Council inadvisable for the town of Foxborough to construct works for the disposal of sewage on the land near Elm Street in the valley of the stream leading to Mansfield, since it would probably be necessary within a few years to provide a larger area than your plans now contemplate for the disposal of the sewage. It appears that there is another area available for the disposal of the sewage of the town to which the sewage can be delivered without excessive cost and the use of which would be unlikely to be objectionable either to neighboring inhabitants or other communities.

A comparison of the probable cost to the town of Foxborough,

based on the estimates of cost of the two plans submitted at the hearing, of disposing of the sewage of the town for a period of ten years on the land near Elm Street, and subsequently constructing works for the disposal of all of the sewage on land near South Street, with the cost of delivering the sewage to the latter area in the beginning indicates that the annual cost to the town might be about the same in each case during that period.

In view of the circumstances, the Council does not approve the construction of works for the disposal of the sewage of Foxborough on land near Elm Street as proposed in the application presented.

FRAMINGHAM.

JAN. 9, 1915.

To the Board of Sewer Commissioners, Framingham, Mass., Mr. F. E. BARRETT, Clerk.

GENTLEMEN:— In answer to your verbal request for information relative to the operation of your sewage disposal works during the year 1914 and for suggestions as to improvements to be undertaken during 1915, it appears from looking over the analyses of samples of sewage and effluent collected during 1914 that there has been a falling off in the efficiency of the purification. Inspections of the filters have shown that sewage remains, sometimes for long periods, on the surfaces of the beds, a condition which is due in part, at least, to the impervious character of the surface material, and probably also in part to lack of proper underdrainage; and a very objectionable odor is noticeable frequently in the vicinity of the beds. These objectionable conditions appear to be increasing from year to year.

This Department has recommended methods of improving the condition of these filters on several occasions, and, while the work of carrying out several of these recommendations has been begun, especially in providing a more even distribution of the sewage over the filter beds, much remains to be done to bring the filters into a satisfactory condition. From the records kept of the distribution of the sewage and from inspection it appears that a large part of the sewage has been discharged, of late, onto beds recently reconstructed, though a greater number of the beds has been used each day than has been the case in previous years. It is, however, impossible to distribute the sewage properly over the filters until the distribution pipes leading to the various filters are enlarged, as has been recommended, and this is particularly necessary now that an additional and larger force main has been installed.

Recommendations made on various occasions by this Department, relative to discharging heavy concentrated sewage pumped from the bottom of the reservoir during the latter part of the period of pumping and early in the following period of pumping onto two or three of the more isolated beds, have not been followed; but, instead, this concentrated sewage, containing great quantities of suspended matter, has been discharged onto a large number of the beds, thereby having a tendency to decrease their efficiency.

During the past year some of the fine material has been removed from certain of the beds and additional underdrains have been installed. This work should be completed as soon as possible and all of the filters brought into a condition of highest practicable efficiency.

It is now evident that the better distribution of the sewage and the work already undertaken will not result in a material improvement in the capacity of the filters unless the other recommendations already made on several occasions are carried out.

The town of Framingham is growing very rapidly and the quantity and strength of the sewage has probably increased as rapidly as in any other town in the State, but the capacity of the disposal works has not been materially increased. An increase in capacity is needed and further increase will be required when sewers now being planned are put into use. The town is again advised to carry out to completion under competent engineering supervision the recommendations made by the State Board of Health under date of Feb. 2, 1914, which are as follows:

. . . The Board recommends that the filters be carefully examined and so much of the surface soil as is heavily impregnated with organic matter removed.

The Board renews its recommendations relative to the use of all of the filter beds so far as possible each day and that the distribution pipes be enlarged where necessary in order that the entire quantity may be discharged onto any one or two beds at a time. The heavy sewage pumped from the bottom of the reservoir toward the end of the pumping and that discharged from the force main early in the morning should be disposed of regularly upon filters especially set apart for that purpose and located as far as possible from the highways. The beds best suited to this purpose appear to be beds 15, 16 and B, and if these filters are used for this purpose they will have a tendency to increase the effectiveness of the remaining filters for the disposal of the ordinary sewage.

It is also important to keep out of the sewers all manufacturing waste of such character as tends to unreasonable clogging of the filter beds. At one of the factories at which settling tanks have been provided for the removal of objectionable matters before the discharge of these wastes into the sewers, the Board is informed that settling tanks have not been properly maintained and that, in consequence, objectionable matter finds its way into the sewers. The settling

tanks should be inspected by your department at frequent intervals and if they are not kept in proper condition for the most efficient sedimentation, the further discharge of these wastes into the sewers should be prevented.

In consequence of the growth of the town and the increase in the quantity of sewage, it is essential to make a material improvement and enlargement in the facilities for purifying the sewage. The inefficiency of these works for the last two years cannot continue without causing serious damage and possible injury to the public health, and the Board recommends that the improvements in the works herein suggested be carried out to completion at the earliest practicable time in the coming spring.

Your attention is also called to the provisions of chapter 433 of the Acts of the year 1909, entitled "An Act to provide for the Proper Maintenance and Enlargement of Works for the Treatment or Purification of Sewage."

JUNE 4, 1915.

To the Joint Committee on Sewerage Extension of the Town of Framingham, Mass.,
MR. ARTHUR C. WINCH, *Secretary.*

GENTLEMEN: — The State Department of Health received from you on May 5, 1915, an application for the approval of an extension of the sewerage system of the town of Framingham to serve the villages of Framingham Centre and Saxonville, accompanied by plans of the proposed works prepared by the town engineer, Mr. J. J. VanValkenburgh, C.E.

The plans provide for the construction of a main sewer in the valley of the Sudbury River, beginning at a point near Franklin Street south of Maple Street and extending through the valley of the river and across the stream at several points, to a proposed reservoir and pumping station to be located near the northerly bank of the river west of Elm Street in Saxonville, whence the sewage is to be pumped to the present filtration area at Eastern Avenue and Speen Street in the town of Natick, where the sewage will be purified in connection with the sewage of the main sewerage system of the town.

The main sewer will be 15 inches in diameter at its upper end and will then gradually increase to a point below Framingham Centre, from which point to the pumping station the diameter of the sewer will be 20 inches. Owing to the fact that the sewer will be laid in the immediate neighborhood, and in places beneath the bed, of the Sudbury River, it is proposed to construct the main sewer of iron pipe laid like a water pipe to prevent the entrance of ground water. At Saxonville the collecting basin and pumping station are designed and so located as to provide for receiving the sewage from all of the thickly settled portions of that village at the present time, including such

portion of the sewage and waste from the mills as it may be deemed necessary or desirable to admit to the sewers.

The Commissioner of Health has caused the locality to be examined by the engineer of the Department and has considered the plans and information presented. The plan supersedes the former plans of separate pumping stations at Framingham Centre and Saxonville and is undoubtedly a great improvement over those plans, since it is likely not only to provide adequate sewerage for these villages at less expense than by a separate system for each village but will also provide sewerage for other territory which may be developed in the future without the construction of separate works. The location of the proposed reservoir and pumping station at Saxonville is a satisfactory one and, if properly constructed and operated, they will not be objectionable in the neighborhood.

The plans submitted do not show additional filter beds, which will be required for the disposal of the sewage of Framingham Centre and Saxonville when sewers have been introduced into these villages. The Department is informed, however, that it is the intention of the town to construct about four acres of additional filter beds, increasing the total filtration area of the town to 24.75 acres. This addition will doubtless be adequate to provide for the extra sewage that is likely to be brought to the filtration area in the beginning by the construction of sewers in these villages, but, after the sewers have come into general use, additional filters are likely to be required, and, in case any of the wastes from the Saxonville Mills are taken into the system, the filters should be enlarged adequately for all requirements before these wastes are received into the sewers.

In the opinion of the Department, the system proposed is an efficient and satisfactory method of collecting and disposing of the sewage of the villages of Framingham Centre and Saxonville and, with the enlargement of the works suggested, the filtration works will be adequate when the improvements now being made there are completed to provide satisfactorily for the efficient purification of all the sewage of the town. It will be necessary, however, to enlarge the filtration works from time to time to meet the increasing quantity of sewage that is likely to be received into the system as the sewers in the new areas come into general use.

GARDNER (PROPOSED ISOLATION HOSPITAL).

MAY 7, 1915.

To the Hospital Building Committee, Gardner, Mass., Mr. FRANK C. DUNN, Acting Chairman.

GENTLEMEN: — In response to your request of April 10, 1915, the Commissioner of Health has caused an examination to be made of the soil in certain test pits in locations available for the disposal of the sewage of the proposed isolation hospital, the results of which show that the material is too fine for the proper disposal of sewage.

Judging from the results of these tests, it will be impracticable to dispose of the sewage of the hospital by means of cesspools, and the best practicable plan will be to construct a filter bed about 50 feet square, upon which the sewage can be delivered in pipes laid about one foot beneath the surface. It will be advisable to build a tank to receive the sewage, so located that the overflow from this tank will discharge into the sub-surface distribution pipes on the filter. The filter should be at least 5 feet in depth and suitably underdrained, and with proper care the underdrainage can be discharged into a stream not used as a source of water supply. Provision for the proper disposal of sludge from the tank should be provided, and it is important that the filter be designed and constructed under the supervision of some one experienced in such work.

AUG. 24, 1915.

To the Hospital Building Committee, Gardner, Mass., Mr. FRANK C. DUNN, Acting Chairman.

GENTLEMEN: — In response to your request, a further examination was made early in the present summer of the conditions about the proposed isolation hospital in Gardner in order to determine the practicability of disposing of the sewage of that institution temporarily by means of cesspools on the grounds.

The results of the examination indicate that it will probably be practicable in the beginning to dispose of the sewage without creating objectionable conditions by discharging it into cesspools constructed along the southeasterly side of the hill on which the hospital is situated. By this plan the sewage will be first received in a tank and thence discharged through a series of cesspools placed about 25 feet apart, to which the sewage would flow in pipes laid with open joints in trenches filled with coarse material. The cesspools should be approximately the same level following the contour of the hill, or at

least with only a slight slope from one cesspool to the next. It is probable that with two, or at most three, cesspools, the sewage can be cared for satisfactorily in the beginning. The trenches between the cesspools should be at least 3 feet in depth, filled with broken stone, and with a pipe 6 inches in diameter laid with its bottom at a level approximately 18 inches below the surface of the trench. It will be practicable, if necessary, to lay additional trenches radiating from the last cesspool along the side of the hill, if further extension is found necessary.

By carrying out this plan it is probable that the sewage can be cared for without creating objectionable conditions, especially while the region southeast of the institution remains uninhabited as at the present time. Whenever the disposal of the sewage by this plan becomes unsatisfactory, a filter bed can be provided as advised in a previous communication, unless it shall be found practicable to dispose of the sewage at that time satisfactorily in some other way.

GARDNER (GARDNER STATE COLONY).

JULY 13, 1915.

To the State Board of Insanity, State House, Boston, Mass.

GENTLEMEN:— The State Department of Health has considered your application for advice as to a proposed system of sewage disposal for the Gardner Cottages, so called, of the Gardner State Colony and has examined the plans prepared by Mr. J. J. VanValkenburgh presented therewith.

The plans are understood to provide only for the disposal of the sewage from the Gardner Cottages, so called, located on the northerly side of one of the highways leading from Gardner to South Ashburnham and containing at the present time a total number of patients and attendants amounting to 133. The plans provide for disposing of the sewage by intermittent filtration upon filters to be constructed on low ground in the valley of a small brook southwest of the highway which passes the cottages. The soil in this location is not adapted to the purification of the sewage by intermittent filtration and the filters are to be constructed artificially of sand and gravel to be brought to this location from the railroad. The works are to consist of four filter beds each 25 feet by 50 feet and a sludge bed 25 feet by 40 feet, all to be underdrained by a 6-inch main underdrain laid through each row of beds with 3-inch lateral underdrains placed 10 feet apart, the depth of material over the underdrains being about 4.5 feet. It is estimated from the quantity of water used at the cot-

tages that the quantity of sewage will amount to about 8,000 gallons per day, and with this quantity the rate of filtration would be about 70,000 gallons per acre per day. The sewage will be discharged to the filters by gravity after first passing through a sludge tank to a flush tank holding about a day's flow of sewage, from which the discharge to the filters will be automatic.

The plans as a whole provide a practicable and satisfactory method of disposing of the sewage of this group of buildings belonging to the Gardner State Colony.

The size of the filters as proposed on the plans presented is adequate for the purification of the present quantity of sewage if the filters are properly operated and receive the necessary care, but there would be considerable advantage in the maintenance of the filters if a somewhat larger area were provided in the beginning, and it is recommended that the area be made somewhat larger than proposed, if practicable, when the works are first constructed.

The operation of the filters could probably be carried on satisfactorily for several years at least with a somewhat smaller dosing tank than is proposed, and the size of this tank could be reduced to 6,000 gallons without serious objection since its capacity could be readily enlarged at a later time if an enlargement should be found desirable.

The effluent from these filters will be discharged into a stream flowing through the grounds of the colony, and it will be essential, in order to maintain the stream in proper sanitary condition, that the filters shall be properly maintained at all times and that the discharge of any crude or imperfectly purified sewage into this brook shall be prevented.

HAVERHILL.

JAN. 18, 1915.

TO HON. ALBERT L. BARTLETT, *Mayor of Haverhill, Mass.*

DEAR SIR:—The Commissioner of Health has considered the application of the City Engineer, Mr. Louis C. Lawton, for advice relative to a proposed sewerage system in Groveland Street near the Groveland Bridge in Haverhill and has examined the plan presented therewith. The plan provides for constructing a sewer designed to carry both the sewage and surface water in Groveland Street and adjacent streets from Keeley Street to an outlet into the Merrimack River at Groveland Bridge. The main sewer will have a diameter of 24 inches to the bank of the river, from which point a 12-inch cast-iron pipe is to be laid beneath the bottom to an outlet in the river about 80 feet from shore and 4.25 feet below mean low water.

It is proposed to provide an overflow for the discharge of sewage and storm water at times of storm from a manhole near the bank of the river at about the level of high water.

An examination of the locality shows that the point at which it is proposed to locate the outlet is one of the original city landings, which does not appear to be used to any great extent at the present time, but there are a coal pocket and pier below the outlet which interfere with the flow of the river at this point, and it is important that the dry-weather flow of sewage should be carried to a point where there is a good current at all times.

The plan in general is a satisfactory one for the collection and disposal of the sewage from the district in question under the existing circumstances, but in order to insure the discharge of the dry-weather flow of sewage into a good current at all times, it is advisable to extend the outlet somewhat farther than shown on the plan submitted. If carried to a point about 50 feet beyond the outlet indicated, or 130 feet from shore, the outlet is likely to be a satisfactory one at all times.

The plan of discharging the mingled sewage and storm water in excess of the capacity of the 12-inch pipe through an overflow at the bank of the river appears to be the best that it is practicable to adopt. Overflows are not likely to be frequent, and objectionable conditions are unlikely to result from this plan of disposing of an excessive flow at times of storms. It is suggested, however, that, if practicable, the main 24-inch sewer above the outlet be constructed with its invert at the lower end at or above grade 6.87, that is about the level of mean high water, so that water would not ordinarily back into the sewer.

With the modifications suggested, the plan, in the opinion of the Commissioner, is a satisfactory one to adopt at the present time.

MARCH 22, 1915.

TO HON. ALBERT L. BARTLETT, *Mayor of Haverhill, Mass.*

DEAR SIR:—The Commissioner of Health received from you on Feb. 18, 1915, through Mr. Louis C. Lawton, City Engineer, an application for advice as to a proposed outlet for the disposal of the dry-weather flow of the Main Street sewer in the Bradford district, accompanied by a plan showing the proposed works. The plan provides for laying a 16-inch iron pipe from a point a short distance back of the present outlet of the sewer to a point of discharge in the Merrimack River about 175 feet from the southerly abutment of the Main Street bridge. According to the plan, the depth of water over the

pipe at the location of the proposed outlet at low tide will be 2.75 feet.

The proposed extension is intended to convey the dry-weather flow of sewage to an outlet in the river, allowing the mingled sewage and storm water flowing at times of rain in excess of the capacity of the submerged pipe to discharge at the present outlet near the bank of the river.

The Commissioner of Health has caused the locality to be examined and has considered the plan presented. The proposed pipe line is of adequate capacity for conveying the dry-weather flow of sewage, together with a considerable portion of the water flowing at times of storms, to the outlet in the river, whence the sewage is unlikely to return to cause the fouling of the banks.

The depth of water at the proposed outlet is not great since the main channel of the river is considerably farther to the north and it would be desirable to extend the sewer to deeper water but, considering the circumstances, the outlet is a permissible one, and its construction will relieve the very objectionable nuisance now caused by this sewer outlet. The main sewer just above the outlet is laid on a steep grade, and it is recommended that the invert of this sewer near the lower end be raised in such a way as to form a sufficient dam to insure the diversion of the entire dry-weather flow into the proposed extension at all times. Danger of clogging at the junction of the pipe with the main sewer may be avoided if the shape of the main sewer in this section is changed somewhat so as to decrease the velocity of flow past the end of the submerged pipe.

It is advisable also that the sharp angle shown in the main outlet pipe beneath the abutment be avoided so far as practicable by the use of a curved pipe at this point, which will tend to reduce danger of clogging. It is recommended that the pipe be laid below the bed of the river.

The plan with the modifications suggested herein will provide satisfactorily for relief from the very serious nuisance now existing at this sewer outlet.

JULY 15, 1915.

To the Board of Water Commissioners, Haverhill, Mass.

GENTLEMEN: — The State Department of Health has considered your communication relative to the construction of a septic cesspool, so called, at the Bradford Pumping Station and has caused the locality to be examined by one of its engineers.

The plan apparently provides for the disposal of the sewage from

the engineer's house alone, and it appears that the location for a septic tank, so called, and a pipe distribution system for the disposal of the effluent from the tank has been selected on the westerly side of the house at a point about 75 feet from the shore of Johnson's Pond.

It is proposed, if this method of disposal is installed, to allow the sewage to filter through the ground to the pond instead of removing it from the neighborhood, as it is understood is now done about four times each year. The Department is not informed as to the character of the soil or the depth to ground water, though apparently the soil in this region is quite coarse and porous, judging from surface indications, and the ground water level is probably low.

In the opinion of the Department, the safest plan of disposing of the sewage from this pumping station is to remove it from the watershed, as is done at the present time, using such methods of removal as will avoid polluting the ground within the watershed. It is probable, however, that, if the soil is porous and the depth to ground water considerable, the sewage could be purified effectively by discharging it from the proposed new cesspool into pipes laid with open joints 2 or 3 feet below the level of the ground. If so placed that the cesspool itself and the radiating drains were all more than 50 feet from the pond, it would comply with the rules for the protection of the water supply.

It is recommended that, before the construction of these works is begun, a test of the ground be made, either by sinking tubular wells or a deep pit, to obtain information as to the character of the soil and depth to ground water.

The Department will be pleased to give you further advice in this matter upon your request when the results of the further tests suggested are available.

SEPT. 21, 1915.

TO HON. ALBERT L. BARTLETT, *Mayor of Haverhill, Mass.*

DEAR SIR:—The State Department of Health received through Louis C. Lawton, City Engineer, on Aug. 27, 1915, the following application for advice relative to changing the location of the proposed sewer around Lake Saltonstall in the city of Haverhill.

I hereby make application to you for advice relative to changing the alinement of a portion of the proposed sewer around Lake Saltonstall, this city. The general plan of this sewer was approved by the board in 1899. By the proposed change a portion of the sewer will pass through the bottom of the lake. This will be an improvement upon both the alinement and the grade and also reduce the cost of construction. The sewer will be constructed of

double strength vitrified pipe thoroughly imbedded in and surrounded by Portland cement concrete. Under separate cover I am sending plans and profile showing the proposed construction.

The plans accompanying the application show the location of the sewer, a part of which is beneath an arm of Lake Saltonstall near its southeasterly end not far from the present intake of the water works. The proposed sewer as it enters the Lake Saltonstall watershed is to be 15 inches in diameter, laid on a grade of .167 per cent., and will have a capacity of about 1,650,000 gallons per day. Farther down, the size of the sewer is to be enlarged to 24 inches in diameter, and it is to be laid on grades varying from .167 to .66 per cent. It is proposed to construct the sewer throughout of double strength vitrified pipe, the portion beneath the lake to be embedded in and surrounded by Portland cement concrete.

The State Department of Health has caused the locality to be examined by one of its engineers and has considered the plans and information submitted. The proposed sewer will have an outlet into the Mill Street sewer, which slopes rapidly to the Merrimack River, and if due care is taken not to introduce so great a quantity of storm water as to cause a surcharging of the sewer, there should be no overflow of sewage from the sewer within the watershed of the lake. It is of the greatest importance, however, that this sewer shall be maintained in proper condition, and if danger of surcharging or overflow of sewage ever appears, the use of Lake Saltonstall as a source of water supply should at once be discontinued. It is recommended that the portion of the sewer beneath the lake and for 50 feet on either side be laid of cast iron pipe with lead joints, constructed after the manner of a water pipe, and that it be thoroughly tested for the discovery of leaks before its use as a sewer is begun.

Lake Saltonstall is already exposed to considerable danger of pollution from the population dwelling within its watershed and from visitors to the shores of the lake, and the source is not, under present conditions, a desirable one from which to take water for domestic purposes on account of its exposure to danger of pollution, though up to the present time efficient inspection has prevented serious injury to the quality of the water. The danger of serious pollution of this lake will increase as the population in its neighborhood becomes greater, and more thorough restriction of access to the lake is desirable in order to prevent danger of serious pollution of the water. If there should be a considerable further increase in the population within the watershed of the lake, this source is likely to become an unsafe one

from which to take water for domestic purposes, unless the water is filtered or treated in such a way as to remove the effects of pollution.

The construction of the proposed sewer within the watershed, if carried out as proposed with the modifications herein suggested, will afford an additional protection to this water supply, provided the sewer is maintained at all times in proper working order.

In the course of construction of the proposed sewer it will be essential to introduce considerable numbers of laborers and teams into the watershed of this water supply, and it is recommended that the use of the lake as a source of water supply be discontinued before construction is begun and that the lake be not again used as a source of water supply until a period of at least two months has elapsed after the work of constructing the sewer has been completed and all refuse resulting from construction has been removed.

Nov. 9, 1915.

To the Board of Water Commissioners, Haverhill, Mass.

GENTLEMEN: — In response to your request, the State Department of Health has examined the plans submitted of a proposed tank and filter to be used for the disposal of the sewage at the engineer's house at Johnson's Pond and has caused a sample of the soil at the location of the proposed works to be analyzed.

The plan provides for constructing a tank 4 feet by 7 feet in plan and 6 feet in depth inside, having a capacity of about 1,000 gallons, into which the sewage will be received and from which it will flow to a trench 15 feet long, 4 feet wide and 4 feet deep to be filled with broken stone and covered with natural soil to a depth of about one foot. The effluent will discharge into the broken stone in the trench through the loose joints of a tile pipe laid along the top of the layer of stone.

An analysis of the soil at the location of the proposed trench indicates that it is quite fine but that it will probably absorb a considerable quantity of sewage which will filter gradually through the ground toward the pond.

The Department has caused the locality to be examined by one of its engineers and has considered the plans and information presented therewith. Considering the size of the cesspool and the proposed trench, and in view of the character of the soil about the trench, it is probable that by this plan the sewage from the engineer's house can be disposed of without objection or danger of serious pollution of the pond for a considerable time in the future. How long a time the plan would operate satisfactorily would depend to a considerable extent on the quantity of sewage discharged from the dwelling and

cannot be estimated definitely. It is probable that in time the trench of broken stone would become clogged, and it would then be necessary to remove and thoroughly clean the material and trench in order to secure effective disposal of the sewage.

As stated in a previous communication, the Department is of the opinion that the safest plan of disposing of the sewage from the pumping station and engineer's house is to remove it from the watershed as at the present time, using such methods as will avoid polluting the ground within the watershed. The plan now proposed, however, will probably provide for the disposal of the sewage without danger of serious pollution of the pond for a considerable time in the future.

In view of the fact that the buildings are located near the shore of the pond beside the intake, it will be essential that the operation of these sewage disposal works be carefully inspected at frequent intervals, and if any signs are found that unpurified sewage is finding its way to the surface of the ground in the neighborhood, the use of the works should be discontinued at once and the sewage carted directly from the tank to a point outside the watershed. It will be essential in any case to note the condition of the tank from time to time and the accumulation of sediment therein and to clean out and remove this sediment at such intervals as may be necessary.

Under the circumstances, it is advisable to retain the present tank for use in case the new system requires cleaning or for any other emergency.

HOPEDALE (DRAPER COMPANY).

To the Draper Company, Hopedale, Mass.

JUNE 9, 1915.

GENTLEMEN: — The State Department of Health received from you on May 29, 1915, through your engineers, Messrs. Metcalf & Eddy of Boston, an application for the approval of certain changes and improvements in the filtration area used for the disposal of the sewage of the town which are outlined in the communication of your engineers as follows:

Bed No. 1. — Raise inlet pipe approximately 6 inches and add 6 inches in depth of new sand.

Bed No. 2. — Lower the lateral drains and main collector to secure the full benefit of the filtering material now in place. This may necessitate lowering the main drain through Bed No. 1, or laying a new drain through this bed.

Raise inlet pipe approximately 3 inches and add 6" in depth of new sand.

Bed No. 3. — Remove all sand and excavate enough material to allow a minimum depth of 2½ feet of sand. Put in new underdrains and main collector, as per M. & E. Plan No. 3099, D-580.

Bed No. 4. — Reconstruct in a manner similar to No. 3, as per plan. The sand and gravel in Beds Nos. 3 and 4 will be utilized in the reconstruction so far as practicable and the waste material will be used for filling, in preparation for the construction of the proposed new filter bed No. 8.

Bed No. 5. — Abandon the use of this bed for the present, connecting the inlet pipe with the distributor on Bed No. 6.

Bed No. 6. — Provide two lines of underdrains, connecting with the main drain from Beds Nos. 1 and 2. This bed is to be reserved for emergency use at times of high sewage flow, or when one or more beds are temporarily out of use.

Bed No. 7. — Add approximately 6 inches in depth of new sand.

Bed No. 8. — (Proposed new bed.) Strip all loam and fill to proper sub-grade, where necessary, with waste material from beds Nos. 3 and 4. Lay new drains as per plan. Build necessary dikes. Bring to proper grade with sand.

A manhole is to be built as shown on plan and gates provided to control the flow onto No. 4 or No. 8. A box distributor is to be provided for this bed, similar to those on the other beds.

Repairs on Distributors. — The present box distributors are to be repaired or replaced, if necessary. Special care will be taken to have these distributors set level, as well as to see that the surface of each bed is made as nearly level as practicable.

Sand Supply. — The Draper Company has at their sand pits a large supply of sand of excellent quality.

The application is accompanied by a general plan of the filtration area showing the proposed new works. It appears that the present filtration works of the Draper Company, which dispose of the sewage of the town of Hopedale, consist of seven filters having a net area of 3.29 acres. The material of which these filters are composed is very variable in character, some of it being very fine and nearly impervious to water. The area is underdrained, but the underdrains in some of the beds are very shallow and in general do not average, according to the information presented, more than 3 feet in depth. The efficiency of these filters is low and it appears that they have been incapable at times of providing for the disposal of all of the sewage discharged from the town, the quantity of which averaged in 1914 about 144,000 gallons per day with a maximum flow in the month of April of about 228,000 gallons per day.

The plans presented provide for raising the distribution pipes from which sewage is applied to the filters, lowering the underdrains, removing some of the poor material, and providing underdrainage having a mean depth of between $2\frac{1}{2}$ and 3 feet. The sand which it is proposed to use is to be hauled from a sand bank about $\frac{3}{4}$ of a mile distant.

The State Department of Health has caused the locality to be examined by one of its engineers and has considered the plans and information presented therewith. In view of the fact that the present filters do not appear to be capable of caring for all of the sewage at all times, it is very important that they be enlarged and improved at the earliest practicable time. The plans now proposed provide for increasing the area by the construction of an additional filter and for improving the underdrainage so that the depth of sand over the underdrains will be at a minimum of 2.5 feet and will average 3 feet or more.

Examinations of samples of the sand from the sand bank from which it is proposed to take the material for the improvement of the present filters and for the construction of the proposed new filter show that, while this material is quite variable in character, some of it being quite fine, material of good quality for the purpose can be obtained from this location. By using the best of the available material, sand of excellent quality for sewage purification can be obtained from the location indicated.

With the improvements proposed and the construction of the additional filter, the area available for the purification of sewage will be about 3.79 acres and the average rate of operation, judging from the measurements of 1914, will be about 38,000 gallons per acre per day, and the rate during the month of maximum flow 60,000 gallons per acre per day.

With an average rate no greater than this, an effluent can be obtained from these works which can be discharged into the Mill River without danger of creating objectionable conditions. It is doubtful whether a much higher rate can be maintained with these filters, however, than is here indicated, and if the average quantity of sewage delivered to the works shall increase materially, a further addition to the works should be made.

With the improvements proposed, provided sand of the best quality is used and provided the sewage is distributed over as much of the area as possible each day, these works will be capable of purifying as efficiently as is necessary at the present time all of the sewage now discharged at these filters, and the Department approves the plans presented.

HUNTINGTON.

AUG. 7, 1915.

To the Board of Selectmen, Huntington, Mass.

GENTLEMEN:—The State Department of Health has considered your application for advice as to a proposed system of drainage and sewerage for the village of Huntington and the plans submitted therewith through your engineer, and has caused the locality to be examined by the engineer of the Department.

The plans provide for utilizing the present drains, four of which discharge into the west branch of the Westfield River, — two on the easterly side and two on the westerly side of the stream, — and the other into the east branch of the Westfield River at East Main Street a short distance above the dam. In addition to these drains it is proposed to construct three new outlets, one into the millpond on the east branch of the Westfield River opposite the junction of East Main and Crescent streets, and the other two into the west branch on its westerly side. The most important of these outlets will be 24 inches in diameter and will receive the drainage and sewage from the greater part of that portion of the village lying west of the west branch. This outlet is to be located about 500 feet below the Main Street bridge and well below the thickly settled portion of the village. The other proposed outlet into the west branch is to be 10 inches in diameter and is to be located about 475 feet below the dam above the woolen mill.

There does not seem likely to be any objection to the discharge of sewage and drainage from the village of Huntington into the east and west branches of the Westfield River as now proposed, provided that the outlets of the drains are so located that the discharge will take place at all times below low water in the river. This will apparently be practicable without serious difficulty in the case of all the drains except the proposed 10-inch drain above the woolen mill. In dry weather most of the water of the river will be discharged through the canal to the woolen mill and there will be comparatively little water at times to dilute the sewage from this outlet, but the quantity of sewage to be discharged here in the beginning will be very small and there are no dwellings at present in the immediate vicinity of the river in this location. If this drain should give trouble in the future the outlet can be extended if necessary to some point farther down stream.

The flow of the Westfield River at the present time is ample for the prompt and effective dilution of all of the sewage likely to be

discharged from the proposed drainage system in Huntington. The plan shows, however, a location for a disposal works to which the sewage can be conveyed for treatment if at any future time the discharge of the sewage into the river should create objectionable conditions.

In view of the circumstances, the Department is of the opinion that the discharge of the sewage into the river without treatment is a reasonable method for disposing of the sewage at the present time, and is recommended with the understanding that the sewage shall be removed from the river and purified or subjected to such form of treatment as may seem desirable whenever such treatment is recommended by this Department.

LAKEVILLE (LAKEVILLE STATE SANATORIUM).

OCT. 15, 1915.

*To the Lakeville State Sanatorium, Lakeville, Mass., SUMNER COOLIDGE, M.D.,
Superintendent.*

GENTLEMEN:—The State Department of Health has considered your application for advice as to the condition of the present system of sewage disposal of the Lakeville State Sanatorium and as to the advisability of securing additional land for the disposal of sewage and has caused the locality to be examined by one of its engineers.

It appears that the total number of patients and attendants at this institution at the present time is approximately 360 and that the quantity of sewage requiring disposal is probably from 30,000 to 40,000 gallons per day.

The sewage from the buildings is at present discharged into series of from three to five cesspools constructed for each of the various buildings. After passing through these cesspools the sewage is discharged intermittently into trenches from $3\frac{1}{2}$ to 5 feet in depth filled with coarse stone, whence it filters into the ground. The soil about these trenches is composed for the most part of very fine sand, with coarser material in some places and clay in others.

By this method it has been practicable up to the present time to dispose of the sewage of the institution without creating seriously objectionable conditions, but the conditions are such that it will probably soon be necessary to provide additional drains or to dig up, clean and relay the drains now in use. The cesspools and distribution drains are located in the immediate neighborhood of the institution buildings, and there are indications that the water supply of the institution, taken from wells not far from the buildings, is be-

coming affected by the discharge of sewage into the ground in their neighborhood. Considering the circumstances, it is advisable that adequate provision be made for the disposal of all of the sewage of the institution upon suitable filter beds at the earliest practicable time.

In the course of this investigation, the Department was informed that plans are being made for securing an area of about 96 acres of land southeast of the institution for dairy purposes, and it appears to be practicable to use a very small part of this area for the disposal of sewage. The results of an examination show that filter beds can be located on this area at a level of 25 feet or more below the present cesspools and that most, if not all, of the sewage can be conveyed to this area by gravity. Much of the soil exposed in two test pits in this area appears to be well suited for the purification of sewage by intermittent filtration, and it is probable that, if a sufficient area — as much as 2 acres — were provided, all of the sewage from the institution could be purified thereon in a more satisfactory way than will be practicable by the continued use of the present works.

If it is decided to use the lands about the proposed new sewage disposal area for dairy purposes, it will be essential to fence the disposal area adequately and to convey the effluent in a pipe line to some point where it is unlikely to be used for drinking or any other purpose.

The Department recommends that definite plans for the purification of the sewage of the institution be prepared at the earliest practicable time, and as soon as such plans are available, the Department will give you further advice relative thereto, if you so request.

LEICESTER.

Nov. 12, 1915.

To the Board of Water Commissioners, Leicester, Mass., Mr. H. O. SMITH, Chairman.

GENTLEMEN: — In response to your request for approval by this Department of the discharge of ground water from the underdrain of the sewerage system of the Leicester Water Supply District into a small brook at the point where it is crossed by Pine Street southwest of the village of Leicester, the State Department of Health has caused the locality to be examined by one of its engineers and samples of the water flowing from the underdrain to be analyzed.

The results of the most recent analyses show that the water flowing from the underdrain at the present time is practically clear, colorless and free from objectionable odor and that it contains no more

organic matter than is ordinarily found in a surface water. In the opinion of the Department, the discharge of this water into the brook at Pine Street would not be likely to create objectionable conditions in that stream at the present time.

The Department is informed that its recommendations of Oct. 29, 1914, relative to the complete separation of the underdrains from the sewers and the removal of all sewage from the underdrains has been thoroughly carried out so that no sewage is now discharged into the underdrain at any time, and so long as these conditions continue it is unlikely that the character of the water flowing from the underdrain will vary materially from what it was found to be at the time of the recent examination.

In view of the circumstances, there appears to the Department no objection to the discharge of the underdrain into the brook at Pine Street as now proposed, so long as the character of this water remains about the same as at the present time. It is advisable, however, that samples of the water of the underdrain and of the brook below the underdrain be collected for analysis from time to time in order that, if any change occurs in the future in the character of the water discharged from the underdrain or objectionable conditions are created in the brook below the point of discharge, the underdrainage water can be diverted from the brook or such other measures taken as may be necessary to prevent the occurrence of objectionable conditions in the stream.

MARION.

Nov. 8, 1915.

To the Board of Sewer Commissioners, Marion, Mass., Mr. HOWARD S. BLANKENSHIP, Secretary.

GENTLEMEN: — The State Department of Health received from you on Oct. 23, 1915, the following application for advice as to the construction of a proposed relief valve and pipe line designed to provide an overflow from your present sewerage system into a town ditch to relieve the system of storm water and ground drainage during the winter and early spring months, said relief valve to be closed during the drier portion of the year.

We have sent under another cover a Blue Print of proposed Relief Valve & Pipe, from manhole on south side of Town Ditch opposite land of Mrs. Sylvia C. Knowlton, Pipe to discharge into Town Ditch, the details of which are set forth on Print.

The purpose of said pipe is to relieve sewer of storm water during winter months & will not be used during the summer. . . .

In the construction of the sewerage system of Marion, large quantities of ground water were encountered, and measurements show that at times there is a very large leakage of water into the sewers in the wetter portion of the year, chiefly in the winter and early spring months. The Department is informed that underdrains were laid beneath some of the sewers when the works were constructed but that on account of the low level of the system as compared with the sea it has not been practicable to provide outlets for these drains at a sufficiently low level to relieve the pressure of ground water about the sewers and the leakage into the system.

The plan now proposed is to discharge a part of the flow in the sewers, chiefly the night flow in the winter and early spring, into a town drain which discharges into Sippican Harbor at a point about 600 feet southeast of the junction of Ryder and Front streets. The town drain is an 18-inch pipe and discharges at a point where the bottom of the sea is only slightly exposed at low water. There is a small area of flats immediately north of the outlet which is uncovered at low water, but the Department is informed that these flats are not used for bathing and that no shellfish of any kind are taken from this region.

In view of the circumstances, the Department is of the opinion that a temporary discharge from your sewerage system during the night only, and then only in the months from November to April inclusive, is permissible for the present.

The large quantity of leakage into the sewerage system in Marion is causing the town considerable expense, both for the maintenance of the system and the purification works, and the cost is not only likely to continue in the future but may increase materially as time goes on. It is, consequently, very important that steps be taken without delay to diminish the amount of this leakage, so far as practicable. It is possible that an examination of the system may show that the greater part of the leakage is confined to a comparatively few sections of the system and that by rebuilding these, with iron pipe if necessary, a large part of the leakage can be prevented. If, however, it is found that serious leakage occurs in a considerable portion of the system, it will be necessary to rebuild the leaky sections so as to bring the system into satisfactory condition.

The Department recommends that you begin at once investigations as to the best plan of preventing unnecessary leakage into the sewerage system of the town. When the results of the investigation are available, the Department will advise you as to the best practicable plan for preventing excessive leakage into your sewerage system and further unnecessary cost for construction and maintenance.

MARLBOROUGH.

JUNE 9, 1915.

To the Board of Water and Sewage Commissioners, Marlborough, Mass.

GENTLEMEN: — The State Department of Health received from you on May 11, 1915, the following application for advice as to a proposed system of sewerage for Ward 6 in the northwesterly part of the city of Marlborough:

We respectfully ask your advice in regard to the proposed extension of the sewer system in this city as shown on the plans sent under another cover known as the Ward Six Sewer Extension.

The work under consideration at this time is shown in red on the general plan, together with plan and profile of proposed trunk line: this serves one hundred and thirty-seven dwellings, with a population of seven hundred and sixty. The levels of this district are such as to prevent the flow of the sewage by gravity to the adjoining system. Three plans were considered for its disposal: viz., Pumping, New Filter Beds, and a Trunk Line to connect with the main trunk line at Phelps Street as shown on plan; this last seems to us as the best all things considered, it will also provide for the disposal of the sewage from the district shown in yellow on general plan when the extension is made there.

The application was accompanied by a plan and profiles of the proposed system of sewers prepared by your engineer, Mr. W. J. Simonds, and later further information was submitted by your superintendent, Mr. George A. Stacy, at the request of this Department, containing portions of the report of your consulting engineers, Messrs. Metcalf & Eddy, relating to the proposed sewers.

The Public Health Council has caused the locality to be examined by one of the engineers and has considered your application and the plans presented therewith. The section of the city of Marlborough for which sewerage is now to be provided lies in the extreme northwesterly part of the city on land sloping to the north, and the topographic conditions are such that the sewage cannot be discharged into the present system by gravity.

In view of the fact that the capacity of the present system is insufficient at times for the removal of all of the sewage to the filtration area, it is not advisable that additional sewage should be discharged into the present system until provision for its enlargement has been made. It appears to be impracticable to secure a suitable area for a separate works for the disposal of the sewage of this district except at large expense. The studies have shown, however, that it is practicable to collect the sewage of the district in question and convey it by

gravity in a sewer extending around the westerly, northerly and easterly sides of Ockoocanganset Hill to the valley of Mowry Brook, and thence in the valley of that brook to a point of connection with the present main sewer of the town at Phelps or Mowry streets, through which the sewage will flow to the present filter beds. A sewer laid on the lines proposed would have the advantage that it would be capable of providing sewerage for other districts in Marlborough which cannot be served by existing systems whenever sewerage in those districts may become necessary, and in view of the circumstances, the proposed plan appears to the Public Health Council as the best that it is practicable to adopt for the disposal of the sewage of the portion of Marlborough under consideration.

The sizes and grades of the proposed main sewer appear to be adequate for all requirements, so far as can now be foreseen, provided the sewers are constructed under competent engineering supervision and that all storm water, and so far as possible all ground water, are excluded from the sewers. This will necessitate not only the careful construction of the main sewer but careful inspection of all connections made with the sewers in the future.

It is understood that a portion of the main sewer, which is to be laid through a meadow, is to be constructed of iron pipe laid like a water pipe, and this is an excellent plan to adopt, wherever practicable, for portions of the line where the main sewer is to be laid below the level of the ground water.

It appears from the report of your consulting engineers that, while definite information as to the sizes and slope of the various sections of the existing main trunk sewer between the point at which it now overflows onto the auxiliary filter beds and the filtration area is not available, the capacity of this sewer is probably capable of removing not only the maximum quantity of sewage which is now discharged into it, but also the extra quantity that will be brought in by the proposed Ward 6 extension without causing the backing up of the sewage and excessive overflow onto the auxiliary filter beds or surcharging the main sewer between this connection and the filtration area.

It is very probable that some relief will have to be provided for the main sewer of the city of Marlborough at no distant time, and the additional quantity of sewage brought in by the Ward 6 sewer will undoubtedly make necessary the relief of the main sewer at an earlier time than would otherwise be the case. Nevertheless, the plan of discharging the sewage into the main sewer at the point indicated appears to be an advisable one under the circumstances.

The capacity of the present Marlborough filter beds has been found

sufficient since the recent enlargements were made to provide for the satisfactory purification of all of the sewage now delivered to these filters, and it is probable that the additional quantity of sewage brought in by the Ward 6 extension can be cared for in addition to the present quantity without necessitating an immediate addition to the works, provided the sewers are so laid that the leakage of storm water and ground water into the system is reduced to a minimum. If on the completion of the system the leakage is found to be large, it will doubtless be necessary to enlarge the filters soon after the sewers are completed.

Under the circumstances it is impracticable to advise you definitely at the present time as to the enlargement of the Marlborough filter beds to provide for the additional sewage that will be brought in from the Ward 6 district, and the question of the necessity for further enlargement can safely be left until the observations shall show the probable amount of increase in the quantity of sewage discharged at the filtration area. It is recommended that a survey be made of the size and grade of the present main sewer of the city of Marlborough, its capacity carefully determined, and if it is found that the capacity is likely to be insufficient to remove all of the sewage likely to be discharged into it without increasing materially the overflow of sewage to the auxiliary filter beds, the capacity of this sewer should be increased at the earliest practicable time.

With the recommendations contained herein, the Public Health Council hereby approves the plan for the collection and disposal of sewage of the portion of Ward 6 in the city of Marlborough as described in the reports and information submitted and shown on the plan presented entitled "General Plan of Proposed Sewer Extension in Ward Six, Marlborough, Mass. Showing Streets to be Sewered and Gravity Line Connection to Present Main Trunk Line Sewer. Scale: 1 in. = 500 ft. April, 1915. W. J. Simonds, Civil Eng."

MAYNARD.

To the Sewerage Committee of the Town of Maynard, Mass.

FEB. 25, 1915.

GENTLEMEN: — The State Department of Health received from you through your engineer, Mr. F. A. Barbour, of Boston, the following application for advice relative to a proposed system of sewerage and sewage disposal for the town of Maynard.

I am authorized by the Sewerage Committee of the town of Maynard to present for your examination and approval plans and report of a proposed sewerage system and sewage treatment works.

As the detailed estimates and the profiles of the lateral sewers are presumably not necessary for your examination of the problem, these are not included, but will be submitted if you so desire.

The design of the treatment works includes settling tanks and sprinkling filters, but in view of the fact that it will be several years before more than 3,000 people will be connected with the sewers, the Sewerage Committee requests your consideration of the feasibility of first constructing the settling tanks and subsequently adding the filters at such date as may be required by your department.

The application was accompanied by plans of the proposed system of sewerage by which the sewage is to be collected and conveyed to disposal works to be located on the westerly bank of the Assabet River about half a mile below the thickly settled portion of the town. The greater part of the population of the town of Maynard is contained in the main village located in the valley of the Assabet River, which flows through the town from the southwest to northeast.

On the southeasterly side of the river the American Woolen Company owns and operates a system of sewerage which at the present time serves 121 of their tenements, the sewage being disposed of by pumping to a filtration area located about $\frac{2}{3}$ of a mile east of the center of the village. This method of disposal can probably be continued for a time at least, but provision has been made for including these houses in the general system of the town. In the remaining portion of the village there are a number of storm water drains, some of which receive sewage, and the plan provides for diverting the sewage from these drains into the new system.

The topography of the town is such that in designing the proposed new system it has been found practicable with little extra cost of construction to divide the town into high and low level districts, the sewage from the former of which will flow to the proposed disposal works by gravity, while that from the latter will have to be pumped after passing through the preliminary treatment tanks. The elevation of the main outlet sewer for the low level district is shown upon the plans at grade 154, while the invert of the main sewer of the high level district at its lower end will be at elevation 170. In two or three places in the collecting system the use of inverted siphons is found necessary.

It is further proposed in connection with the collecting system to lay underdrains beneath the sewers in places where ground water is likely to be encountered in order to reduce as much as practicable the leakage of ground water into the sewers.

The disposal works, which have been designed on a basis of an

estimated daily flow of 500,000 gallons per day with an allowance for future extensions when necessary, consist of an Imhoff tank of such capacity that when flowing at the rate of 500,000 gallons per day the sewage will be about 2.4 hours in passing through the tank, a sprinkling filter $\frac{1}{4}$ of an acre in area and 7 feet in depth, with a secondary settling tank having a capacity above the pyramidal hopper bottom of about 20,000 gallons, and sludge beds having an area of 2,000 square feet to receive the sludge from the Imhoff tank. The plan also includes other necessary appurtenances, including dosing tanks for the sprinkling filter and pumping machinery.

Since it is not proposed to construct any of the high level intercepting sewers in the beginning, all of the sewage will be conveyed to the disposal works through the low level interceptor, and the sewage after passing through the Imhoff tank will be pumped to the filter.

The Commissioner of Health has caused the locality to be examined by one of the engineers of the Department and has considered the plans and information presented.

The system is well designed for collecting the sewage from all of the thickly settled portions of the town and disposing of it, so far as practicable, by gravity in a satisfactory manner. Special care has been taken in the design of the system to exclude ground water, and it is very important that the precautions suggested be fully carried out in the construction of the works, since an excessive and unnecessary amount of leakage into the sewers would entail, a large extra expense in the construction of the works and an unnecessary annual outlay in their operation and maintenance.

The introduction of inverted siphons appears to be necessary at certain points in the system, and their use is not likely to give trouble in connection with a system like this if they are properly constructed and all surface water is excluded from the sewers so far as possible, as proposed.

The disposal works are adequate for the treatment of the sewage likely to be discharged into the system for several years after the works are built, and, if constructed as designed, they are likely, with proper care in maintenance and operation, to purify the sewage sufficiently to permit its discharge into the Assabet River without further treatment until the quantity of sewage requiring disposal exceeds considerably the amount likely to be discharged into the system in the earlier years of the operation of the works.

In view of the condition of the Assabet River, it is advisable, in the opinion of the Department, to construct the sprinkling filter in the beginning, including the secondary settling tanks required for the

sedimentation of the effluent from this filter. While the experience in the operation of sprinkling filters for the disposal of the sewage of cities and towns in this climate is somewhat limited, the indications are that a sprinkling filter of greater depth would secure a better effluent and make it practicable to operate the filter at a higher rate than with shallower filters and secure an equally satisfactory effluent. It is suggested that, if practicable, this modification be made in the construction of the filter. The efficiency of the filter will also depend upon the size of stone to be used which remains to be determined before the works are constructed.

The works as a whole are well designed for the collection and disposal of the sewage of Maynard and, with the modifications herein suggested, will provide adequately for the purification of the sewage until the population becomes greater than at the present time.

METHUEN (BARKER SCHOOL).

JUNE 23, 1915.

TO MR. WALTER M. HASTINGS, *Chairman, School Committee, Methuen, Mass.*

DEAR SIR: — In response to your request for an examination of the sanitary conditions at the Barker School, so called, at the corner of Lowell and Forest streets in Methuen, and advice as to the disposal of sewage therefrom, the Commissioner of Health has caused the locality to be examined by one of the engineers of the Department and has considered the information presented.

It is understood that it is now planned to change the sanitary arrangements at this school by providing flush water-closets in the basement to discharge into a tank and thence into a private sewer which has an outlet on the ground south of the junction of Lowell and Orchard streets, where the sewage of several houses and considerable storm water are already discharged.

It is estimated that the total quantity of sewage to be disposed of from the school would be about 2,500 gallons per day. This sewage, if discharged through a septic tank as proposed, would become putrid, and the quantity is such that, in connection with the other sewage discharged from the present sewer, there would be danger that a serious nuisance would be created at the outlet of the sewer. There is little doubt, however, that a suitable filter bed might be constructed in the neighborhood of the present sewer outlet to receive the sewage and, with a suitable filter bed, the sewage could be purified to such a degree that there would be no objection to discharging the effluent from the filter upon the adjacent ground or into a neighboring water course.

If it is not practicable to secure an area of land on which to dispose of the sewage near the outlet of the present sewer, the best plan would probably be to construct a large cesspool in the rear of the schoolhouse lot not far from the present privies, with a trench along the northerly and westerly sides of the lot leading to another cesspool in the southwesterly corner, whence the overflow could be discharged into the sewer.

Judging from the information furnished by a test pit which has already been dug in these grounds, the cesspools should be as much as 6 feet in depth and the trench between them 3 feet wide and at least $5\frac{1}{2}$ feet in depth. The lower 3 feet of the trench should be filled with broken stone $\frac{1}{2}$ inch in diameter or thereabouts or coarse gravel, and a distribution pipe about 6 inches in diameter should be laid with uncemented joints with its bottom about one foot beneath the surface of the broken stone or gravel in the trench. The discharge pipe from the first cesspool should have an elbow at its upper end so arranged that the sewage will flow out of the cesspool about one foot beneath the surface of the sewage. It will be impracticable to provide water-closets at the level of the basement if used in connection with cesspools, and provision will have to be made to place them at a sufficiently high level to avoid danger of interference with their operation by reason of the height of the ground water. With this arrangement it is possible that the sewage from the building could be disposed of for a few years without serious difficulty or expense.

It would be much better, however, to take care of the sewage from this school in connection with that of the dwelling houses in the neighborhood temporarily upon a filter bed south of Lowell Street for a few years until a system of sewerage can be provided for this section of the town.

NAHANT.

MARCH 2, 1915.

To the Board of Selectmen, Nahant, Mass.

GENTLEMEN: — The State Department of Health received from you, through your engineer, Mr. Ernest W. Bowditch of Boston, an application for advice with reference to two proposed sewer outlets on the northerly and southerly sides respectively of Little Nahant, through which it is proposed to dispose of the sewage of that section of the town by discharging it directly into the sea, and in response to this request the Commissioner of Health has caused the locality to be examined.

The plan submitted provides for collecting the sewage of the north-

erly part of this small peninsula by means of sewers in Nahant Road, Wilson Road, Lennox Road, and Simmons Road and discharging it at an outlet near the northeasterly end of the peninsula about 160 feet from shore at a point where the water is 4 feet in depth at low tide. For the southerly part of the peninsula the plan provides for sewers in Little Nahant Road, Simmons Road, Baker Road and Wilson Road, leading to an outlet also located about 160 feet from shore and 500 feet southeast of the eastern point of the peninsula where the depth of water is about 4 feet at low tide.

The sewers are designed for the removal and disposal of the domestic sewage from the territory indicated on the plan, and, on account of the small area of the peninsula and the probability that many of the dwellings will be occupied only during the summer season, the quantity of sewage to be disposed of will be small.

Under the circumstances, the discharge of sewage at the proposed outlets is unlikely to create objectionable conditions in the adjacent waters unless the quantity of sewage discharged at these points becomes much greater than seems reasonable to expect at the present time.

In view of the circumstances, it is recommended that the sewage be discharged at the outlets indicated on the plan without treatment until such time as an increase in the quantity of sewage, or other change in the conditions, makes a treatment of the sewage, or an extension of the outlets to deeper water, necessary or desirable.

NORTHFIELD (NORTHFIELD HOTEL COMPANY).

APRIL 6, 1915.

*To the Northfield Hotel Company, Northfield, Mass., Mr. AMBERT G. MOODY,
Manager.*

GENTLEMEN:— The Commissioner of Health received from you on March 31 the following application for advice as to the proposed system of sewerage for that portion of the village of Northfield not already sewered lying north of Warwick Brook.

The Northfield Hotel Company of Northfield, Mass., submit for your approval plan of a Sewerage System. The plan in general provides for the disposal of the sewage from that portion of the Village (not already sewered) lying North of Warwick Brook as shown on the accompanying plan. The sewage from this portion of the village will flow by gravity to a common main outlet, discharging into the Connecticut River at a point about 1,000 feet north of the Central Vermont Railway Bridge.

It is proposed to construct the sewer from the River as far as The Northfield Hotel at present. In the future, an intercepting sewer will be laid through the valley to a point near the Seminary Farm Buildings. The sewers will provide outlets for lateral sewers in North Lane, Pine and Aldrich Streets and Glenwood Avenue on the west, and also for any street that may be constructed on the easterly side of the valley.

The application is accompanied by a general plan of the proposed system showing the location of the main sewers, together with their sizes and grades.

The system as a whole appears to be well adapted for the collection and disposal of the sewage of that portion of the village of Northfield which it is designed to serve, and the sizes and grades of the sewers insure an ample capacity for the disposal of all of the sewage at all times. In fact, the size of that portion of the main sewer in Highland Avenue might be reduced from 12 inches to 10 inches in diameter and that portion in private land between Highland Avenue and the farm buildings from 12 inches to 8 inches in diameter without danger of interfering with the efficiency of the system if the sewers are properly and carefully laid. The location of the outlet in the Connecticut River, according to the information submitted, would be about 20 feet beyond the river bank at low water at which point the outlet would be covered by about 4 feet of water at times when the river is low. It is possible to extend the outlet to a point about 40 feet from low water where the outlet would be covered with 6 feet of water at periods of low flow, and it is advisable that the outlet be carried out at least as far as that point. This point is approximately 80 feet from the top of the river bank.

With an outlet located at the point herein suggested, the discharge of the sewage into the Connecticut River is, under existing conditions, a permissible method of disposal for the sewage of the portion of the village of Northfield shown on the plan presented. It is very important that these sewers and their future extensions be constructed strictly upon the separate plan in order that unnecessary expense for separating the sewage from the storm water may be avoided in case treatment of this sewage before its discharge into the river should become necessary at some future time.

NORWOOD (WINSLOW BROS. & SMITH COMPANY).

JUNE 9, 1915.

To Hon. HENRY C. ATTWILL, *Attorney-General, State House, Boston, Mass.*

DEAR SIR:— In response to your request of May 5, 1915, for an examination and report upon plans of Messrs. Metcalf & Eddy, Engineers, of Boston, in relation to the proposed trickling filter for the treatment of liquid manufacturing waste from the tannery of the Winslow Brothers & Smith Company at Norwood, the Commissioner of Health has caused the locality to be examined and has considered the plans presented. The Commissioner has also considered the results of an experiment upon the purification of the waste from their works made by the Winslow Brothers & Smith Company, under the direction of their engineers, by applying this waste to a small trickling filter of broken stone $7\frac{1}{2}$ feet in depth, operated at an average rate of about 750,000 gallons per acre daily, twenty-four hours per day, with one day's rest in seven, for a period of about one year from May, 1914, to April, 1915. This experimental filter has an area at the surface of about 850 square feet, or 0.02 of an acre, and the filtering material consists of broken stone between 1 inch and 2 inches in diameter. The effluent from this trickling filter was discharged into a settling tank having a capacity of about 2,200 gallons, and thence to a sand filter having an area of about 200 square feet and a depth of about 4 feet, with suitable underdrains. The Commissioner of Health has also considered the results of experiments carried on at the Lawrence Experiment Station upon the treatment of this waste by filtration through both trickling and sand filters at various times.

Based on the experiments of their engineers, the Winslow Brothers & Smith Company now propose to construct a permanent plant for the treatment of the waste from their works, the proposed plant to consist of a trickling filter about one acre in area and 7.5 feet in depth, the filtering material to consist of broken stone from 1 inch to 2 inches in diameter. About $\frac{3}{4}$ of an acre of this filter is to be built in the beginning.

It is apparently estimated by the engineers from their investigations that the quantity of waste to be treated will not be greater than 500,000 gallons per day and that, in consequence, the rate of operation of the proposed filter will be between 600,000 and 700,000 gallons per acre per day. The average character of the waste before treatment, as shown by analyses made by this Department, is as follows, in parts

in 100,000:—total solids, 377.8; suspended solids, 35.1; loss on ignition, 69.1; loss on ignition, suspended, 26.1; free ammonia, 4.3; total albuminoid ammonia, 2.0; oxygen consumed, 23.9. If the proposed trickling filter gives results equal to those of the experimental filter which has been operated at Norwood for the past year, and there is no reason to expect that the results from the large filter will differ materially from those of the experimental filter if the latter is maintained under competent engineering supervision, it is to be expected that, if the applied waste remains of about the same character as during the period of this test, the character of the effluent of the trickling filter will be about as follows, in parts in 100,000:—total solids, 349.1; suspended solids, 28.6; loss on ignition, 42.6; loss on ignition, suspended, 19.2; free ammonia, 1.8; total albuminoid ammonia, 1.5; oxygen consumed, 13.9.

The effluent of the trickling filter is to be passed through sedimentation tanks and then discharged into Hawes Brook. The analyses of the effluent of the experimental sedimentation tanks have averaged as follows during the period of its operation, in parts in 100,000:—total solids, 323.7; suspended solids, 11.3; loss on ignition, 30.8; loss on ignition, suspended, 6.2; free ammonia, 2.0; total albuminoid ammonia, 1.0; oxygen consumed, 9.8.

The examinations of this settled effluent indicate that it is capable of further decomposition, and the discharge of this quantity of waste containing so great a quantity of organic matter into the river would, in the opinion of the State Department of Health, be a violation of the provisions of chapter 360 of the Acts of the year 1906.

The Winslow Brothers & Smith Company, however, have also conducted an experiment upon the treatment of this effluent after sedimentation by filtration through sand, the average results of analyses of the effluent of the experimental sand filter during the period of its operation having been as follows, in parts in 100,000:—total solids, 309.7; suspended solids, 2.7; loss on ignition, 18.2; loss on ignition, suspended, 0.8; free ammonia, 0.6; total albuminoid ammonia, 0.3; oxygen consumed, 4.9. These results indicate that the treatment of the general waste from these works by the trickling filter and settling tanks as proposed and subsequent filtration through sand filters will effect a reasonably satisfactory purification of these wastes. The area of sand filters already constructed at their works appears to be adequate for such further filtration of the effluent from the trickling filter and settling tanks which they now propose to construct without material addition to the works.

In the opinion of the State Department of Health, if the works

proposed by Messrs. Metcalf & Eddy for purifying these wastes are constructed and their operation continued under competent engineering supervision, and if the effluent from these proposed works is subsequently filtered through the sand filters already in existence, with such improvement as may be found necessary in these filters, the works will then be capable of providing adequately for the best practicable purification of the wastes from this factory so long as they do not exceed an average quantity from month to month of 500,000 gallons per day.

The Commissioner deems it desirable to call your attention to the fact that the works now proposed do not provide for the treatment of the rinse water from wool scouring which contains a considerable quantity of organic matter, the amount being sufficient at times at least to cause serious pollution of Hawes Brook. It is recommended that, if this rinse water is not to be treated separately with such effectiveness as to remove the objectionable and polluting matters therefrom, it be included with the general waste from the factory and the works enlarged sufficiently to provide for the proper treatment of all the waste.

AUG. 24, 1915.

To Winslow Brothers & Smith Company, Norwood, Mass.

GENTLEMEN: — In accordance with the provisions of chapter 360 of the Acts of the year 1906, section 2, the State Department of Health hereby advises you that the best practicable and reasonably available means of rendering harmless the waste or refuse discharged by you at your works at Norwood into Hawes Brook, a tributary of the Neponset River, is in the opinion of the Department the construction of a trickling filter of adequate size to be used in connection with settling tanks and sand filters by which said waste or refuse shall be treated.

The Department is of the opinion that with such works of adequate size the refuse and waste of the quantity and character now being discharged by you into Hawes Brook can be purified to such an extent that they will not thereafter be injurious to the public health or tend to create a public nuisance.

Upon the construction of the trickling filter of adequate size operated in connection with the necessary settling tanks, experience may show that the maintenance and operation of sand filters for the further treatment of the effluent from the trickling filter will be unnecessary to insure that there will be no violation of the provisions of chapter 360 of the Acts of the year 1906, and in that case you will of course not be required under the present law to maintain and operate them.

The Department realizes that by giving this advice it can in no way protect you from prosecutions under the provisions of the act, but feels confident that if the advice given is followed out the results obtained from the use of these filters will be such as not to warrant prosecution on the part of prosecuting officials.

PEABODY (T. H. O'SHEA LEATHER COMPANY).

JUNE 15, 1915.

To Mr. FRANK EMERSON, *Town Engineer, Peabody, Mass.*

DEAR SIR:— In response to your request, an examination has been made of your proposed plans for a settling tank at the works of the T. H. O'Shea Leather Company in Grove Street, Peabody, and a further examination has been made of the quantity and character of the wastes discharged from these works.

The results of these examinations show that, as stated by the owners of the tannery, the amount of the waste liquors has been somewhat reduced and amounted at the time of the recent examination to about 16,000 gallons per day. Furthermore, the character of the wastes has been considerably improved owing to the changes in the processes carried on at the works.

The plan submitted provides for a settling tank in the rear of the tannery having a capacity of about 12,500 gallons. It is to be 19 feet in length, 11 feet in width, and will have an effective depth of about 8 feet. The bottom of the tank is designed to slope toward a valley in the center, and the valley will slope toward the side from which the sludge is to be discharged. The wastes entering the tank will be discharged into a trough across one end from which it will overflow over the edge of the trough into the settling tank, and a similar arrangement is to be provided at the outlet of the tank.

The Commissioner of Health has caused the locality to be examined by one of the engineers of the Department and has considered the plan presented.

The capacity of the tank appears to be adequate for the proper sedimentation of these wastes, which contain a very large proportion of suspended matter. It is not advisable to provide a deep baffle in the middle of the tank as proposed, but one or two scum boards should be placed near the outlet of the tank to arrest the flow of floating matter from the tank. The slopes of the bottom of the tank are probably not sufficient to cause the sludge to flow toward the central valley and, under the circumstances, unless the slopes are to be much

steeper, at least 45 degrees or preferably 60 degrees, it would be better to make the bottom of the tank nearly level, with a deep valley as proposed through which to discharge the sludge.

It may be necessary in the future to use a coagulant to secure more efficient sedimentation. This could be done by introducing about 100 pounds of lime per day for the present daily flow, and it will be desirable to make provision in the construction of a tank for introducing a coagulant in the future.

While the proposed tank, with the modifications suggested, will probably remove from these wastes all of the solid matter that it is practicable to remove by sedimentation, the location of the tank is such that it will apparently be very difficult to draw off and properly dispose of the sludge therefrom. It is very important, if the settling tank is to be operated satisfactorily, that it be drawn off at frequent intervals so as to prevent the accumulation of sludge therein and consequent material reduction of the period of sedimentation. There appears to be available land for the location of this tank outside of the building, and it is recommended that it be so located that the sludge can readily be discharged from the tank and removed from the neighborhood. If it is found practicable to change the location of the tank, it would probably be of advantage to construct the tank in two compartments having an aggregate capacity somewhat greater than that proposed for the single tank.

PEABODY (J. F. INGRAHAM COMPANY).

JUNE 16, 1915.

TO MR. FRANK EMERSON, *Town Engineer, Peabody, Mass.*

DEAR SIR:— In response to your request for advice as to a proposed settling tank and sludge bed at the tannery of the J. F. Ingraham Company used for the sedimentation of their wastes before their discharge into the trunk sewer, a further examination of the works has been made and additional samples of the wastes have been analyzed.

The results of the analyses show that the wastes from this tannery contain a very large quantity of solid matter, a large proportion of which is in solution, and that it is not practicable to remove any great quantity of matter from these wastes by sedimentation. The wastes contain much grease and a considerable quantity of fine dust which collect upon the surface of the liquid when standing and can be readily removed.

The quantity of wastes at the time of the recent measurements amounted to about 4,000 gallons per day, and when mixed with lime

in sufficient amount a large quantity of organic matter is precipitated. Consequently, there is little doubt that, when mixed in the sewers with waste containing large quantities of lime, there will be a precipitation of organic matter from these wastes. The quantity of the wastes, however, is small, so that serious trouble may not be caused if they are passed through a suitable settling tank before discharge into the sewers.

It is advisable to make certain changes in the details of the design of the tank as submitted in order to facilitate its operation. As now designed, the bottom of the tank slopes toward the middle and there is a longitudinal slope from the inlet to the outlet end of the tank. The sludge is of such a character that it will cling to the bottom unless the slopes are made considerably steeper than shown in this design, and if it is impracticable to secure slopes toward the center of as much as 45° , or preferably 60° , it would be better to make the bottom of the tank practically level, since the sludge could be removed therefrom with less difficulty than from sloping sides unless the slope was sufficient to insure the flow of the sludge to the lower end of the tank.

The plan of admitting the waste liquor to the tank by discharging it into a trough from which it will overflow in a thin film along the full width of the tank is an excellent one to adopt, and with this arrangement it is not advisable to place a screen or a deep baffle in the middle of the tank, as shown on the plan. It will probably be sufficient if scum boards are placed near the outlet of the tank to intercept the grease and dust.

The proposed sludge bed is of inadequate capacity to receive the sludge discharged from the proposed tank and should be enlarged materially. It may be difficult to build a sludge bed large enough to receive the entire contents of the tank, and in that case provision should be made for drawing off the supernatant liquor in the tank back to the pump well before discharging the sludge from the tank. It will consequently be necessary to provide a sludge bed in any case that will be of such capacity that, if used in connection with the pump well as suggested, it will be capable of receiving the full discharge from the tank.

It is important to locate the sludge bed at a sufficient level above the ground water and above the elevation of the water in the brook to insure its proper operation at all times.

An inspection well or other means of obtaining access to the effluent from the tank, in order that it may readily be examined, should of course be provided in accordance with the regulations established by this Department.

PEABODY (THAYER-FOSS COMPANY).

JUNE 23, 1915.

To the Thayer-Foss Company, Peabody, Mass., Mr. HARRY I. THAYER, President.

GENTLEMEN:—The Commissioner of Health received from you on June 11, 1915, an application for advice as to proposed sedimentation tanks for the treatment of your wastes at Peabody before discharging them into the sewerage system of the town, accompanied by plans of the proposed works prepared by your engineer.

The plans provide for the collection of all the wastes from the tannery into an existing tank located beneath the tannery floor, from which they will be discharged into a proposed pump well 4 feet by 6 feet in plan and about 13 feet deep. From this pump well the wastes are to be pumped to a group of sedimentation tanks arranged in pairs. The first tank of each pair is to be 8 feet by 8 feet in plan and 9 feet 3 inches deep and is expected to collect hair in suspension in the wastes. From these "hair tanks" so called, the waste liquors are to overflow into sedimentation tanks 30 feet by 8 feet 2 inches in plan and having a mean depth of about 7 feet. These tanks are to be in duplicate, the capacity of each of the "hair tanks", so called, being about 4,000 gallons, and the capacity of each of the settling tanks about 12,800 gallons. Sumps are to be provided in the bottom of each of the latter tanks in which suction pipes are to be placed for removing the sludge by pumping to a sludge-drying bed to be constructed adjacent to the tanks. Sludge beds are also to be provided to receive the sludge from the "hair tanks". All sludge beds are to be provided with underdrains having an outlet in the existing tank under the tannery.

The Commissioner of Health has caused the locality to be examined by one of the engineers of the Department and has considered the plans presented.

The quantity of wastes discharged from this factory has been found at times to amount to as much as 80,000 gallons per day, and the period of sedimentation provided by the proposed settling tanks, on the basis of a flow of 80,000 gallons in ten hours, would be 2.1 hours when one pair of tanks is in use and 4.2 hours when both pairs of tanks are in use. If the tanks are properly maintained and operated together, it will be practicable to remove the heavier matters from these wastes and prevent the further discharge of such matters into the sewers. It is suggested that provision be made for discharging the wastes into the so called "hair tanks" over a weir, instead of

through a single pipe about 3 feet above the bottom of each tank as is proposed at present. It is also advisable that the screens between the outlet of the settling tanks and the sewer be made of bars placed much closer together than proposed or preferably of a mesh screen having a mesh of not over $\frac{1}{4}$ of an inch. In the construction of the screen chamber it would apparently be practicable to leave an opening back of the screens for the inspection of the wastes discharging into the sewer, which would afford more convenient access to these wastes than the 10-inch pipe proposed. If this arrangement is not practicable, however, a pipe of larger diameter than 10 inches should be used.

In order to secure efficient results in the operation of these works, frequent cleaning of the tanks will be necessary, and it is essential that, at times of cleaning when the tanks are drawn off, the discharge of sludge into the screen chamber and thence to the sewer shall be avoided. With the present arrangement, by which a gate will be open in the side of the tank at a certain elevation above the bottom, there is much danger that, if a considerable amount of sediment has accumulated in the tanks, a portion of it will be drawn off with the wastes and be discharged through the screen chamber into the sewer. It would be much better if the whole contents of the tanks could be discharged upon the sludge bed and the sludge bed made large enough for that purpose. If not, it would be advisable to arrange for drawing off the liquor in the tanks through floating arms, or some such arrangement as would avoid danger of discharging sludge into the sewer. If floating arms are impracticable, it would probably be better to draw off one of the tanks at a time, discharging the supernatant liquor into the pump well and pumping it with the wastes to the settling tanks in operation while the other two tanks are being cleaned. There would seem to be no great difficulty in making this arrangement, and with such an arrangement danger of discharging large quantities of sludge into the sewer would be avoided.

The Commissioner of Health is of the opinion that the proposed tanks, with the modifications suggested, will, provided the tanks are properly operated, remove from these wastes the heavier matters which are likely to cause trouble in the sewers.

PITTSFIELD.

AUG. 12, 1915.

To the Board of Public Works, Pittsfield, Mass.

GENTLEMEN:— The State Department of Health received from you on July 20, 1915, through your engineer, an application for advice as to a proposed extension of the sewage disposal works of the city of Pittsfield, accompanied by two plans of the proposed works marked Sheets 1 and 2 entitled "City of Pittsfield. Addition to Filtration Beds."

The plans presented provide for increasing the present filtration area by the construction of eleven filters having an aggregate net area of about 9.56 acres northeast of the present filters, and by the construction of about 4.26 acres of additional filters along the southerly side of the present filtration area. Samples of the soil from test pits in the area in which these filters are to be located have already been examined by this Department, the results showing that the material in the proposed northeasterly extension is in general of excellent quality for the purpose, while that south of the present filter beds is quite fine, much of it being of rather poor quality for the purification of the sewage by filtration.

It is proposed to underdrain the filters of the northeasterly addition by the construction of underdrains at depths ranging from 3.5 to 4.5 feet, the underdrains being placed 35 to 45 feet apart. In the southerly addition the underdrains are to be similar but it is proposed to place the drains not more than 30 feet apart.

The plans also provide for extending the distribution pipes so as to convey the sewage to the additional areas. It is understood, furthermore, that the plans are to include the underdrainage of the filters bordering the railroad, and that further improvements are under consideration in this region which will enable the city to utilize more fully the capacity of these filters in the future.

The Department has caused the locality to be examined by its engineer and has examined the plans presented. The proposed additional filter beds will increase the area available for the disposal of the sewage of the city of Pittsfield about 50 per cent. and will make the aggregate area available for this purpose about 41.42 acres. The rate of filtration will thereby be reduced from about 128,000 gallons per acre per day, which is the rate at the present time, to about 79,000 gallons per acre per day with the quantity of sewage now discharged at the area. This rate will be somewhat difficult to maintain, and in view of the fact that the city is growing rapidly the

additions now being made will no more than bring the filtration area up to the present requirements, and still further provision for the disposal of the sewage of the city will be needed in the immediate future unless some reduction can be made in the quantity of sewage requiring treatment.

There is no doubt that a large portion of the water supplied to the city of Pittsfield is wasted and that much of this waste finds its way into the sewers. The total quantity of water consumed by the city in 1914 amounted to about 5,800,000 gallons per day, or about 150 gallons per person. This quantity is, as you have already stated in your report to the City Council, out of all proportion to the requirements of the city, and it is probable that some reduction might be made in the quantity of sewage if the excessive waste of water were prevented.

It is advisable under the circumstances that a careful survey of the water distribution system be made to determine whether there is any considerable leakage therefrom. If no considerable leakage is found it is then advisable that a thorough inspection be made of all the water fixtures within the premises of consumers of water and that meters be placed where any leakage or excessive use or waste of water is discovered. Experience shows, however, that while it is practicable to reduce for a time the waste of water in a city or town by inspection of the water fixtures, it is impracticable as a rule to secure permanent reduction in the waste of water except by a practically universal application of meters.

It is possible also that some further reduction in the quantity of sewage requiring disposal might be made by reducing the amount of leakage into the sewers, but the expense of the elimination of leakage might be larger than the cost of providing additional purification works. It is nevertheless worth while to make a careful examination of the sewers to determine whether there is any particular sewer or area in the city in which there is more leakage than in other portions, and whether a material reduction in the flow of sewage can be made by eliminating that leakage. If it is found impracticable, however, to reduce the flow of sewage by the elimination of leakage into the sewers or a reduction in the waste of water, it will be necessary for the city to provide immediately for the further enlargement of its sewage disposal works.

The Department, after considering the plans presented, is of the opinion that they will, if carried out as proposed, provide an important and much needed addition to the sewage disposal works of the city. The efficiency of the proposed additional filters at the southerly

side of the filtration area may be found to be considerably less than in other parts of the area, but in that case it will probably be practicable to increase the efficiency of these filters by constructing in the finer portions trenches of coarser material to which the sewage could be applied. These filters, however, may in practice be found to operate in a reasonably satisfactory manner.

The Department recommends that the question of reducing the quantity of sewage by the prevention of leakage be taken up at the earliest practicable time, and if such prevention is not found practicable, that the question of further enlarging your sewage purification works be given immediate consideration.

SALISBURY (SALISBURY BEACH).

To the Salisbury Water Supply Company, Salisbury, Mass.

MAY 7, 1915.

GENTLEMEN:—The State Department of Health has considered your application for the approval of plans for a system of sewerage and sewage disposal for that portion of Salisbury known as Salisbury Beach and has examined the plans presented.

These plans provide for collecting the sewage of Salisbury Beach into a main sewer to be laid along the westerly side of the beach from the New Hampshire line to an outlet into Black Rock Creek at a point about two thirds of a mile south of the point where the creek, or canal, is crossed by the road leading from Salisbury to the beach. The southerly end of the beach is to be served by a sewer running northerly to a junction with the main sewer a short distance above its outlet, and there are to be tributary sewers to serve various sections of the beach not served by the main sewer.

The discharge of sewage into Black Rock Creek is to be regulated by means of a tank, located just above the sewer outlet, in which the sewage will be collected during the incoming tide and discharged automatically on the outgoing tide. The plans presented show a tank of two compartments, each 30 feet in length by 8 feet in width by 7.5 feet in depth, thus having a total capacity of about 25,000 gallons. The outlet of this tank as shown on the plans presented is a pipe 20 inches in diameter, at the upper end of which are double 18-inch tide gates designed to close the outlet of the tank during the period of the incoming tide and until the water on the outgoing tide has fallen below the level of the sewage in the tank.

The Commissioner of Health and members of the Department have examined the locality relative to the need of sewerage at Salisbury Beach and the proposed plan of collecting and disposing of the sewage.

In the opinion of the Department, an improved sewerage system is greatly needed in this densely populated area, both to provide more extended means for the collection of the sewage and to prevent as soon as practicable the discharge of the sewage upon the beach which at the present time creates very objectionable and unsanitary conditions in the summer season when the beach is used for bathing. The proposed method of disposing of the sewage by discharging it into Black Rock Creek is a permissible one to adopt under the circumstances and if, on account of the increasing quantity of sewage discharged there or from other cause, the conditions become objectionable in the future the sewage can be disposed of either by purification upon filter beds or by discharge into the Merrimack River near the outlet of Black Rock Creek, where a suitable outlet can be located.

The proposed location of the storage tank and outlet into the creek at a point about 3,300 feet south of Broadway appears to be a reasonable one to adopt at the present time, and if objectionable conditions should subsequently occur by reason of the discharge of sewage into the creek at this point the outlet can be extended to a point of discharge 1,800 feet farther down stream whenever necessary without changing the location of the tank. Moreover, the tank can be used as a pump well if treatment of the sewage or its discharge into the Merrimack River becomes necessary at some future time. It is advisable that the tank be built in the beginning to have a capacity of not less than 25,000 gallons, that its floor be placed at about 2.6 feet above mean low water, and that the tank be provided with at least two manholes to give access for cleaning and proper circulation of air wherever cleaning may be necessary.

The sewers should be constructed and maintained strictly on the separate plan and the entrance of surface water and ground drainage prevented so far as possible, in order that the quantity of sewage to be disposed of may be reduced to a minimum. The careful construction of all connections with the sewers is also essential to this end. It is recommended that a sufficient number of connections be made between the sewers and the water mains to insure proper flushing of the sewers whenever necessary, and it is further suggested that an emergency outlet be provided from the main sewer above the tank or that a by-pass be constructed around the tank in order to discharge the sewage directly into the creek whenever it shall become necessary to discontinue the use of the tank for repairs or other cause.

With the modifications herein suggested, the disposal of the sewage of Salisbury Beach into Black Rock Creek by discharging it from a tank on the outgoing tide at a point at least 3,300 feet below Broad-

way is hereby approved, said outlet to be discontinued and the sewage to be discharged at some point farther down the creek or disposed of in some other suitable manner whenever, by reason of the increase in the quantity of sewage discharged or the occurrence of objectionable conditions in the creek, or other cause, a change in the outlet becomes necessary.

STONEHAM.

SEPT. 9, 1915.

To Mr. C. J. SWEENEY, *Superintendent Public Works, Stoneham, Mass.*

DEAR SIR: — The State Department of Health has considered your application for advice as to the proposed location of a main sewer in the Lincolnville District in Stoneham and has caused the locality to be examined by one of its engineers.

The plans and report of your consulting engineer submitted with the application provide for the sewerage of a district in the southwesterly section of the town draining naturally through a small tributary of Sweetwater Brook, a branch of the Aberjona River. This district contains at the present time nearly fifty houses and, owing to the very fine subsoil and underlying ledge, much difficulty has been experienced in the proper disposal of the sewage from these dwellings.

The plan provides for the construction of a main sewer 8 inches in diameter laid on a steep grade through low wet land between Glen Road and Atwood Avenue from the neighborhood of Park Street to an existing sewer in Maple Street. It is proposed to provide an under-drain beneath this sewer for the collection of ground water which is to be discharged into the brook just below West Hancock Street.

There appears to be no more practicable location for the proposed main sewer in existing streets or elsewhere than in the low land in the neighborhood of the brook, and a right-of-way can undoubtedly be secured there by a purchase or taking under existing laws.

The plan as a whole appears to be the best practicable method of providing a main sewer outlet for the district described in your application, and the Department recommends its adoption.

WAKEFIELD.

To the Wakefield Water and Sewerage Board, Wakefield, Mass.

MAY 7, 1915.

GENTLEMEN: — The State Department of Health received from you on April 30, 1915, the following application for the approval of a proposed sewer in Park Avenue, Dell Avenue, Stedman Street and private land between Wakefield-Stoneham town line and Converse Street: —

Your approval of the proposed sewer, in Park Ave., Dell Ave., and Stedman Street is requested. Shown on profile left at your office.

The location of sewers in these streets was shown on a plan of sewerage approved by the State Board of Health in February, 1901, but being in dotted lines their construction was not approved at that time. The plan now presented — which is a slight modification of the plan previously presented — was considered and approved by the Public Health Council at its meeting held on May 4, 1915.

WELLESLEY.

JUNE 25, 1915.

*To the Sewerage Committee of the town of Wellesley, Mass., Mr. W. H. BLOOD, Jr.,
Chairman.*

GENTLEMEN: — The State Department of Health received from you on June 22, 1915, an application for the approval by the Department, under the provisions of chapter 567 of the Acts of the year 1907, of a system of sewerage for the town of Wellesley, accompanied by a plan of the proposed works.

Upon receipt of this application, the State Department of Health gave notice of a hearing upon said plan at its office, Room 143 State House, on June 23, 1915, at 11.00 A.M., by publication of said notice in "The Townsman."

At this hearing no one appeared to object to the plan presented by the engineer of the town. After the hearing and a consideration of the plan, the Department voted to approve the system of sewerage proposed for the town of Wellesley and shown on the plan accompanying the application, said plan being entitled, "Sewerage for Wellesley, Mass., 1915. Ernest W. Bowditch, Engineer, Boston, Mass." (Scale: 1"=600').

WESTBOROUGH.

JUNE 14, 1915.

*To the Board of Sewer Commissioners, Westborough, Mass., Mr. IRA M. BEAMAN,
Chairman.*

GENTLEMEN: — The Commissioner of Health received from you on April 26, 1915, the following application for advice as to the advisability of admitting to the Westborough sewers the waste from the proposed bleaching department of the Westborough Weaving Company.

We have received an application from the Westboro Weaving Company to dispose of the waste from their proposed bleaching department through our

public sewers. We understand that they will use chloride of lime and sulphuric acid in solution in some form. We request that they submit to your board details as to the chemicals and the quantities and the method of disposal of the same into the sewer. We should be pleased to have, as early as possible, an opinion from the State Department of Health as to whether it would be safe to accept this sewage on the conditions that they wish to put it into the sewers.

The information submitted to the Department is to the effect that the materials, consisting of braids, tapes, etc., are to be first boiled for several hours in a kier containing about 5,000 gallons of water to which caustic soda is added, and subsequently rinsed through fresh water. They are then to be treated in an acid bath which it is said will be discharged not oftener than twice a year. After this treatment, the materials will be washed twice, about 5,000 gallons of water being used each time, though with certain qualities of product it is expected that a much larger quantity of water may be used. The average amount of waste liquor from this establishment, as nearly as can be determined, will be about 50,000 gallons per week, the discharge taking place on two days only, except occasionally when an extra amount of dilute wash water will be discharged.

The Commissioner of Health has caused the locality to be examined by one of the engineers of the Department and samples of the various wastes to be analyzed. Analyses of the waste from various processes similar to those to be carried on at these works show that the waste liquor discharged from the treatment in the kier with caustic soda contains a large quantity of organic matter even after the second wash, and the acid waste has an acidity of from 98 to 155 parts in 100,000.

Investigations have also been made to determine the probable effect of these wastes upon the Westborough sewage in case they should be admitted to the sewers. The results of the investigations indicate that these wastes, if they do not exceed in actual volume 50,000 gallons per week, may probably enter the Westborough sewers and pass to the filtration area without causing objectionable conditions in the sewers or affecting unfavorably the operation of the filtration plant, provided this quantity of waste is discharged in such a way as to be distributed quite evenly throughout the twenty-four hours on at least six days of the week. It is important, furthermore, that, before discharge into the sewers, the acid liquor should always be mixed and neutralized by the alkaline discharge. It is not certain, however, that some further treatment of these wastes will not be required at the works before they are admitted to the sewers so as to insure their thorough mixture at all times.

If these wastes are admitted to the sewers, it is recommended that they be admitted only on the condition that the discharge into the sewers be placed in charge of a chemist or engineer at the works, whose duty it will be to insure their being discharged into the sewer throughout at least six days of the week, and on the further condition that, if it shall be found at any time that the discharge tends to create objectionable conditions in the sewers or at the filter beds, it shall be discontinued at once.

WESTFIELD.

JUNE 9, 1915.

To the Board of Selectmen, Westfield, Mass., Mr. JOHN L. HYDE, Town Engineer.

GENTLEMEN: — The Commissioner of Health received from you on May 21, 1915, through Mr. John L. Hyde, Town Engineer, an application for advice as to a proposed system of sewers for the district adjacent to Franklin Street between Congress and Lloyd's Hill streets, the sewage to be discharged into an existing 20-inch drain leading from the State road at a point about 650 feet west of Congress Street to the Westfield River, and in response to this application has caused the locality to be examined and has considered the plan presented.

The reason given for discharging the sewage into the storm water drain in this manner is to relieve the present sewerage system, which is already overtaxed at some seasons of the year. It is very important, in the opinion of the Department, that sewage and storm water be kept wholly separate in the town of Westfield, in view of the fact that it will be necessary for the town at no distant time to provide for the purification of its sewage before its discharge into the Westfield River or its tributaries, and, under these conditions, it is essential to keep storm water separate from the sewage in order to avoid excessive cost in the construction and maintenance of sewage disposal works.

In view of the fact that the present sewerage system of the town is overtaxed, it is not of course advisable to discharge a further additional quantity of sewage into the system until relief has been provided. Under these circumstances, the discharge of the sewage of the district in question temporarily into a storm water drain appears to be the least objectionable method of disposal to adopt at the present time. In the construction of the sewer, however, provision should be made to exclude all roof water and, so far as practicable, all storm water, as well as ground water, and if need arises for removing storm water, separate pipes should be provided for that purpose.

It is recommended that studies be made and plans prepared at the earliest practicable time for the enlargement of the sewerage system of

the town and relief from the present surcharging of the sewers at certain times, and these plans should include the diversion of the sewage of the Franklin Street district indicated on your plan from the storm water drain and its disposal in connection with the sewage of the other portions of the town.

WEST SPRINGFIELD.

To the Board of Selectmen, West Springfield, Mass.

MARCH 11, 1915.

GENTLEMEN: — In response to your request of Feb. 24, 1915, received through your engineers, for advice as to a proposed plan of sewerage in the valley of Block Brook having an outlet into the Westfield River, the Commissioner of Health has caused the locality to be examined and has considered the plan presented.

The plan provides for sewers in Westfield Street running easterly from Ohio Avenue and westerly from the neighborhood of Wilder Terrace to a main sewer in the valley of Block Brook through which the sewage from these sewers and from tributary sewers in Ohio Avenue and Rogers Avenue will be conveyed to a proposed outlet into the Westfield River.

It is evident from an examination of the locality that surface drainage is needed in portions of this region, but in order to remove any considerable portion of the surface water from the region which these sewers are designed to serve, it would be necessary either to construct sewers of very large size to convey the entire flow of sewage and surface water to the Westfield River or to provide overflows into Block Brook. It is not desirable that Block Brook in this region, which is likely to become populous at no distant time in the future, should be polluted by sewage, even though pollution would occur only at times of rain. If all surface water, and so far as practicable all ground drainage, were kept out of the sewers, pipes of much smaller size than proposed would be adequate for the disposal of all of the sewage of the district. There is, moreover, no objection to the discharge of surface drainage, if not polluted by sewage, into Block Brook or any of its tributaries. By utilizing the existing watercourses, deepening and improving them if necessary, adequate drainage can be provided with short drains in the streets emptying into the nearest watercourses, and in this way drains of comparatively small size will be adequate for all requirements.

Under the circumstances, it is recommended that the sewers be constructed strictly on the separate plan and that all surface water, and so far as practicable ground drainage, be excluded.

The discharge of the sewage into the Westfield River without treatment appears to be a reasonable method of disposal to adopt at the present time, but if the conditions should change and this method of disposal become objectionable, the use of this outlet is to be discontinued or a satisfactory method of purification of the sewage provided when required by this Department. The location of the outlet into the Westfield River as proposed appears to be a satisfactory one, but it is essential that the pipe be carried out into the stream to a sufficient distance from the bank so that it may be covered at times of low water and the sewage may mingle quickly with the current of the river and avoid fouling the banks.

When the details of the outlet into the Westfield River are prepared, we will advise you concerning them, if you so request.

WRENTHAM (STATE SCHOOL).

SEPT. 22, 1915.

To the Wrentham State School, Wrentham, Mass., Dr. GEORGE L. WALLACE, Superintendent.

GENTLEMEN:— In response to a communication from Elias A. Wood of Norfolk relative to the operation of the sewage filter beds at the State School, the State Department of Health has caused the locality to be examined and samples of the effluent from the filter beds to be analyzed.

The results of the examination do not show that at the present time the effluent causes a nuisance in the brook below the filter beds, and no odor was noticeable in their neighborhood. There are growths of organisms in the brook below the filter beds which are very probably fostered in part at least by the nitrates in the sewage effluent. The filter beds were in a satisfactory condition at the time of the examination, but the siphon leading to the filters does not operate satisfactorily and should be reconstructed. It is advisable also that distribution troughs be constructed on the filters or other means provided for distributing the sewage more evenly over the filters and that all of them be used, so far as practicable, each day, except such beds as may be out of use for the purpose of cleaning. It would be of advantage in the operation of the filters, and doubtless also in the maintenance of proper conditions in the brook, if the State should acquire control of the channel of the brook and of land on either side so that the bed of the stream could be lowered and its channel kept clear of growths of organisms and other obstructions.

It is recommended that the control of the brook be acquired and that the changes herein suggested be made at the earliest practicable time.

SEPT. 22, 1915.

TO HAROLD E. FALES, Esq., *Badaracco Block, North Attleborough, Mass.*

DEAR SIR: — Since receiving your communication of July 14, 1915, relative to the complaint of Mr. Elias A. Wood of Norfolk as to the operation of the filter beds at the State School at Wrentham, the State Department of Health has caused these filters to be examined and samples of the sewage applied to the filters and effluent therefrom to be analyzed.

The recent examinations show that the operation of these filters has been materially improved and that they are at present being operated in a satisfactory manner. Under the conditions now existing there appears to be no cause for complaint of the condition of these filters or of the effluent therefrom.

A copy of a communication to the superintendent of the institution relative to these filters and the conditions in the brook below them is enclosed.

MISCELLANEOUS.

The following is the substance of the official action taken during the year in reply to applications for advice relative to the pollution of streams and miscellaneous matters: —

ATTLEBORO (Y. M. C. A.).

SEPT. 22, 1915.

To the Health Department, Attleboro, Mass., RALPH P. KENT, M.D., *Health Officer.*

GENTLEMEN: — In reply to your request for an examination of the swimming pool at the Young Men's Christian Association in Attleboro and advice as to its condition, the State Department of Health has caused the pool to be examined and samples of water from the pool and of water supplied thereto to be analyzed.

The results of the analyses show that the water in the pool contains a very large amount of free and albuminoid ammonia, is high in chlorine and contains a large number of bacteria. It is evident from these results that the water is very badly polluted, probably by urine. It is recommended that the water be drawn entirely out, the

bottom and sides of the tank thoroughly cleansed, and that thereafter an effort be made to prevent the further serious pollution of the pool by those who use it.

DEC. 31, 1915.

To the Health Department, Attleboro, Mass., RALPH P. KENT, M.D., Health Officer.

GENTLEMEN: — In response to your request of Oct. 20, 1915, stating that the swimming pool at the Young Men's Christian Association had been thoroughly cleaned and requesting a further examination thereof, the State Department of Health has caused the pool to be examined and additional samples of the water to be analyzed.

The results of the analyses show that the quantity of organic matter at the inlet of the swimming pool has been greatly reduced and that a large reduction has also been effected in the quantity of organic matter present in the water standing in the pool. The water still contains a considerable quantity of organic matter, however, and a large number of bacteria, though the number of objectionable bacteria present was small.

The condition of the pool is on the whole greatly improved and does not now differ materially from that of similar pools. The water in this pool should be analyzed from time to time and the pool emptied and cleansed at sufficiently frequent intervals to keep it in proper sanitary condition.

BELCHERTOWN (PROPOSED SCHOOL FOR FEEBLE-MINDED).

Nov. 29, 1915.

To the State Board of Insanity, State House, Boston, Mass.

GENTLEMEN: — The State Department of Health has considered your applications received Oct. 21 and Nov. 8, 1915, for advice as to certain proposed locations for a school for the feeble-minded in the western part of the State and has caused the three localities indicated, situated respectively in the towns of Conway, Belchertown and Southwick, to be examined by one of its engineers.

The area which it is proposed to acquire in the town of Conway is situated in the northerly part of that town and borders the southerly side of the Deerfield River between Bear River and South River. A branch of the New York, New Haven & Hartford Railroad, Northampton Division, passes along the border of this tract adjacent to the Deerfield River with a station at the southeasterly edge of the tract, and there are two stations on the Fitchburg Division of the Boston & Maine Railroad adjacent to a part of the tract. The station at

Bardwell Ferry on the Fitchburg Division is approximately opposite the middle of the tract and is connected therewith by a highway bridge, from which a road passes through the area. There is also a trolley line parallel to the South River at the southerly edge of the tract.

The elevation of the area as shown upon the State topographical map ranges from about 260 feet to 550 feet above mean sea level in the southerly part of the tract and 840 feet near its northwesterly limits. The area slopes to the northeast and the higher lands of the northern portion are covered with heavy timber, while most of the southern portion is cleared and largely under cultivation.

The Department is informed that the proposed institution may contain ultimately a population of 2,000, and the area has been examined with a view to obtaining a water supply for an institution of that size. There are numerous small springs in the central portion of the tract, but a general examination fails to show any location within its limits from which it is likely that an adequate quantity of good water for the requirements of the institution could be obtained. Water could be taken from one of the rivers adjacent to the area by constructing a reservoir and purifying the water by filtration, but the cost of a water supply under such conditions would be large. It is probable that a supply could be obtained at less cost by constructing a reservoir upon one of the small brooks in this region, the water of which might be used without filtration, if a location could be obtained within a reasonable distance of the area which it is proposed to acquire. So far as can be judged from the State map, however, the streams in the immediate neighborhood of this area are small and a careful study would be necessary before it would be practicable to determine whether or not a suitable water supply could be obtained in that way at a reasonable cost, but the indications for a gravity supply are very poor.

The disposal of sewage from the buildings on this area would probably be a simple matter, since the sewage could probably be discharged after sedimentation directly into the Deerfield River without serious objection so long as the condition and uses of that stream remain as at the present time.

The Belchertown site is located west of the central part of the village of Belchertown and is bordered along its northwesterly side by the tracks of the Central Massachusetts and the Central Vermont railroads, each of which has a station at Belchertown close to the easterly limit of the tract. As shown upon the State map, the elevation of the ground in this area ranges from about 360 to 480 feet

above sea level and slopes in a northwesterly direction toward Bachelor Brook. Two small brooks, uniting near the northwesterly portion of the area, discharge into Bachelor Brook about a mile north of the tract. The southwesterly part of the tract is covered largely with a growth of heavy timber, and there are limited areas of woodland at other points in the central portions of the tract. The land in the neighborhood of the streams is swampy in places and much of it is covered at present with a dense growth of alders and other underbrush.

Judging from surface indications, a water supply for an institution at this location could probably be obtained from the ground within the limits of the area. It will probably also be practicable to locate sewage filters within this tract for the purification of the sewage of the institution, and, on account of the location, an efficient system of sewage disposal will be necessary. Since the best location for a water supply is in the valley of the main stream which drains the tract, it will be essential that any sewage disposal area located within this watershed shall be so placed that it will not affect the quality of the water supply. The best practicable location for filter beds appears to be in the southwesterly portion of the tract.

The Southwick site, so called, is located about midway between the thickly settled portions of the towns of Southwick and Westfield, and only a very small portion is within the latter town. The land slopes generally to the east, the greater part of it being within the watershed of Slab Brook, so called, though the extreme northerly portions of the area slope toward the northeast and the southwesterly portions toward the west and south.

It is impracticable to determine from a general examination of this area whether or not it will be possible to obtain a suitable water supply for the institution from any source within the tract, though a ground water supply might perhaps be obtained in the lower grounds in the southeasterly part of the area. The best plan of securing a water supply would probably be to take water from the works of the city of Springfield, the principal pipe line of which passes about half a mile north of the northerly portion of the tract. It may also be possible to obtain water from the town of Westfield by extending a suitable pipe line from the Westfield system to this area.

The disposal of the sewage from buildings located upon this tract may involve a considerable expense, since a very efficient purification of the sewage is necessary, and even with the most efficient purification practicable, objection may be made to the discharge of the effluent into any of the neighboring streams. It will probably be

feasible, however, to locate adequate sewage filters in the north-easterly part of the tract for the purification of the sewage, but if it should not be found desirable to discharge the effluent into any of the adjacent streams, the effluent could undoubtedly be disposed of satisfactorily by conveying it to an outlet in the Westfield Little River, a distance of about $1\frac{1}{2}$ miles. It is probable that the effluent could be discharged into the Westfield Little River by gravity, though a survey will be necessary before this question can be determined. The elevation of this area ranges from 250 to a maximum of about 440 feet above mean sea level, and much of the higher ground is covered with a heavy growth of wood. The easterly part of the tract consists largely of cultivated land, and there is very little swamp except at two or three places near the sources of two small streams in the southwesterly part of the tract.

The nearest railroad line to this tract is that between New Haven and Northampton with a station at Southwick, about $2\frac{1}{2}$ miles south-east of the area.

Comparing the three tracts so far as the practicability of securing an efficient water supply is concerned, it appears likely that considerable difficulty might be encountered in securing a proper water supply at reasonable cost for the Conway tract, while a water supply for the Southwick tract could probably be secured from the Springfield or the Westfield pipe lines without special difficulty, though it would probably be necessary to pump the water from the former source at least in order to supply it under sufficient head. It seems likely that an adequate water supply can be obtained within the limits of the Belchertown tract without special difficulty, and the expense would not be likely to be much greater than the expense of obtaining a water supply for the tract at Southwick, so far as can be judged from the limited information available at the present time.

As regards sewage disposal, less difficulty is likely to be encountered at the Conway tract than in either of the other locations, while at Southwick the disposal of the sewage is likely to involve considerable expense. So far as can be judged then from the information at present available, the cost of efficient systems of water supply and sewerage, taken together, is likely to be less on the whole at the Belchertown area than at either of the others, and probably somewhat less at the Southwick area than at Conway, where, while sewage disposal appears to be a simple matter, the securing of a suitable water supply system is likely to prove a difficult problem.

BEVERLY.

JAN. 29, 1915.

TO MR. AUGUSTUS P. LORING, Jr., *Chairman, Planning Board, Beverly, Mass.*

DEAR SIR:— Your request for information concerning the Dane Street bathing beach and the information relative to the conditions affecting the bathing on this beach have been considered by the Commissioner of Health.

In answer to your first question, the most recent examinations of this beach have shown that floating matters discharged at the Beverly sewer outlet, located about 700 feet from the westerly end of the beach, are at times cast up upon the beach as far east as Ocean Street in the period of the year when the locality is used for bathing. Under these circumstances, there is danger to the public health in the continued use of this beach for bathing.

With regard to your second question, whether if a bathhouse were erected on the beach there would be any chance in the future of public bathing privileges being cut off by this Department on account of the pollution of the water, it is impracticable to give you any definite reply. It may be said, however, that there is no law at present in force which gives this Department power to prevent the use of this beach for bathing.

As to the third question, since the cause of the pollution of the water near the beach is the discharge of sewage from the Beverly sewer outlet, it is probable that the conditions at the beach will be dependent to a large extent upon the quantity of sewage discharged at this outlet and that the conditions will vary with the direction of the wind and the state of the tide. The quantity of sewage discharged at the present outlet will of course increase in the future with the growth of the city.

In answer to the fourth question, there appears to the Department no method by which the condition of the water at this beach can be improved except by removing the sewer outlet from its present location to some point where the sewage will not be carried back upon the beach.

The question of disposing properly of the sewage of the city of Beverly has been before this Department several times in the past and has been under consideration by the city of Beverly for several years. It seems to the Department important that the question of properly disposing of the sewage shall be thoroughly investigated and a suitable place of disposal provided at the earliest practicable time.

BRAINTREE.

JULY 2, 1915.

To the Board of Health, Braintree, Mass.

GENTLEMEN: — In response to your request of Nov. 28, 1914, the State Department of Health has made observations of the odors from the burning cinder pile of the New York, New Haven & Hartford Railroad between Braintree and South Braintree for several months past and has not found at any time that objectionable odors were noticeable beyond a few hundred feet from the fire, and in no case in the last four months has any odor been noticeable at any of the dwelling houses in the neighborhood that could be distinguished from the odor noticeable from the roundhouse in which the locomotives are kept. The fire appears to have been effectually confined by means of trenches to an area of about four acres and has been gradually diminishing. So far as the investigations of this Department show, the odors from this area do not appear to constitute a nuisance.

The Department will be pleased to continue the observations, if you think it desirable to do so, and will inform you from time to time as to the results.

CONWAY (PROPOSED SCHOOL FOR FEEBLE-MINDED). (See BELCHERTOWN.)

DANVERS.

MAY 12, 1915.

To the Board of Health, Danvers, Mass.

GENTLEMEN: — In response to a request from the board of health of Peabody, the Commissioner of Health has caused an examination to be made of the condition of the clams taken from the flats in the Danvers River near Danversport, and a copy of the communication from this Department to the board of health of Peabody is enclosed herewith.

The Department will communicate to you the results of further investigations of the condition of clams in the Danvers River, the investigation of which is now being made. In the meantime, it is advisable that your department give notice to the public of the danger involved in the use of clams for food from the area indicated.

OCT. 6, 1915.

To the Commissioners on Fisheries and Game, State House, Boston, Mass.

GENTLEMEN: — Complaint having been made that clams are taken from polluted areas in the Danvers River and offered for sale as food, the State Department of Health has caused an examination of the Danvers River and its estuaries to be made to determine the sources of pollution thereof and the condition of the waters and flats therein and has caused samples of clams from these flats to be analyzed.

The results of the examination show that the flats and waters along the Beverly shore between Woodberrys Point and Tucks Point are very badly polluted by sewage from the main sewer outlet of the city of Beverly and that clams from these flats are unsafe for use as food.

The flats near the junction of the Bass River with the Danvers River and all of the flats examined in the Danvers River west of the Boston and Maine Railroad bridge and in the estuaries of the Danvers River, known as the North River, the Waters River, the Crane River and the Porter River, are badly polluted and clams taken therefrom are unsafe for food.

As a result of its investigations, the State Department of Health finds that the flats within the Danvers River and Beverly Harbor west of a line drawn from Woodberrys Point to Old Hospital Point are contaminated by sewage or manufacturing waste and that shellfish taken therefrom are unsafe for use as food. The Department hereby requests the Commissioners on Fisheries and Game to prohibit the taking of any clams or quahogs from the flats and waters herein described until further notice.

FAIRHAVEN.

DEC. 14, 1915.

To the Fairhaven Improvement Association, Fairhaven, Mass., C. E. P. THOMPSON, M.D., Chairman.

GENTLEMEN: — In response to your request for an examination of the water of New Bedford harbor at the foot of Pease Street, Fairhaven, where the location of a public bathing pavilion is being considered, the State Department of Health has caused the locality to be examined by one of its engineers and samples of the water to be analyzed.

There is a sewer outlet of the town of Fairhaven at the Fairhaven end of the New Bedford bridge north of the proposed location of the bathhouse and two other main outlets at Union Wharf about one-third of a mile south of this location. A large quantity of sewage is

also still discharged into New Bedford Harbor from numerous sewer outlets on the New Bedford side.

The results of analyses of the sea water show that it contains considerably more free ammonia than is found in the sea water of the bay, but the pollution at the present time is not serious and the location indicated appears to be the best that it is practicable to secure along this shore for the purpose in view. It is probable that the pollution of the harbor will diminish with the extension of the New Bedford intercepting sewer, and if the waters along the Fairhaven shore should become seriously polluted from the Fairhaven outlets the objectionable conditions could probably be removed by extending these outlets to a greater distance from the shore.

In view of the conditions, the waters of the harbor at the foot of Pease Street can probably be used with safety for bathing unless pollution of the harbor in this region by sewage becomes greater than at the present time.

GARDNER (CONTAGIOUS DISEASE HOSPITAL).

MARCH 5, 1915.

To the Hospital Building Committee, Gardner, Mass., Mr. SETH HEYWOOD, Chairman.

GENTLEMEN: — In response to your communication received through Mr. Harold Field Kellogg, architect, of Boston, relative to a contagious disease hospital to be located on the southerly slope of Bickford Hill in Gardner, the Commissioner of Health has caused the locality to be examined and has examined the general features of the plan presented.

The plan provides for a hospital with accommodations for eighteen patients which will care for contagious diseases, though the plans do not show a ward for tuberculosis.

The building will be supplied with water from the Gardner water works, and the supply should be adequate and satisfactory.

The hospital is so situated that the sewage can, if desired, be discharged into one of the sewers of the town of Gardner by gravity, and this would be the best plan of disposing of the sewage. The hospital will be located at a considerable distance from the nearest town sewer, however, and it is thought probable that considerable rock might be encountered in laying a pipe to connect with that sewer, and in view of these circumstances it is planned to dispose of the sewage, for the present at least, by a tank and a system of cesspools with underground drains, through which the sewage will leach into the soil. It is impracticable to make an examination at this season of the year

which would determine definitely whether or not it would be possible to dispose of the sewage by cesspools. If the soil is sufficiently porous to absorb the quantity of sewage discharged from the hospital and prevent unpurified sewage from overflowing onto the surface of the ground, this method of disposal can be used without objection. If, however, the soil is unsuitable for the disposal of the sewage satisfactorily by this method, it may be necessary to construct a sub-surface filter by hauling sand or gravel to a suitable location in the neighborhood of the hospital. If constructed in this way, a filter 50 feet square, having an area of 2,500 square feet, would probably be sufficient, providing the filtering material were as much as 5 feet in depth. The sewage could then be disposed of through pipes beneath the surface of the filter, which should be properly underdrained.

As soon as the conditions become favorable in the spring, it is advisable that the soil be carefully examined to determine whether the disposal of the sewage in cesspools and underground drains is likely to be practicable under the circumstances. The Department will assist you in this investigation, if you so request, by making the necessary examinations of the soil as soon as conditions are favorable for such examinations and will then advise you further as to the best practicable plan of disposing of the sewage.

The location and plans are approved subject to further consideration of the matter of sewage disposal.

LYNN.

MAY 7, 1915.

TO MESSRS. DANIEL H. HOLLIS, JOHN E. CHEEVER, FRANK VAILE and Others, *Lynn, Mass.*

GENTLEMEN: — In response to your petition for an examination of the three clam flats in the vicinity of the city of Lynn and advice as to whether the clams obtained therefrom may safely be used for food, the Commissioner of Health has caused the flats indicated to be examined and samples of clams taken therefrom to be analyzed.

Of the samples collected in Lynn Harbor all were found to contain bacteria characteristic of sewage. These clams are probably affected by sewage discharged upon the flats in this neighborhood and are unsafe for use for food. The clams from all of the flats examined within the Pines River were found to be badly polluted and unfit for use. The clams taken near Little Nahant showed a wide variation in the number of bacteria present, the number present at times being very high, and in view of these results this area cannot be regarded as a safe source from which to take clams for food.

The least polluted clams were found on the ocean side of the Point of Pines, but even here the clams taken at different times from this flat have shown considerable variation. Those collected in the latter part of March were low in bacteria, and at that time these clams were probably safe for domestic use, but samples collected about a month later showed the presence of greater numbers of bacteria, including those characteristic of sewage. Under the circumstances, these clams also must be regarded as unsafe for food.

Clams were found abundantly in all the flats examined in Lynn Harbor but, until some provision has been made for removing the sewage which now greatly pollutes these flats, the use for food of clams taken from these areas would be likely to cause sickness and cannot be approved at the present time.

NEW BEDFORD.

MARCH 13, 1915.

To the Board of Health, New Bedford, Mass., Mr. WILLIAM G. KIRSCHBAUM, Agent.

GENTLEMEN: — In response to your request for advice as to a change in the location of the public bathhouses from the westerly shore of Buzzards Bay to a location on the easterly shore of Clark's Cove at the end of Valentine Street, about 2,000 feet north of the screen house on the intercepting sewer, the Commissioner of Health has caused the locality to be examined and samples of the sea water at the proposed location to be analyzed.

The results of the analyses show that the sea water at this point is badly polluted by sewage at the present time and the location is not a safe one for the purpose proposed. It appears, however, that the sewage of the main intercepting sewer is at present being discharged through a temporary outlet near the screen house, and this sewage on an incoming tide spreads along the shore in a northerly direction toward the proposed location for the new bathhouse.

The condition of the sea water in this region is probably much worse than it will be after the temporary discharge of sewage at the screen house has been discontinued. Under the circumstances it is probable that if a further examination of the sea water at the location indicated were made two or three weeks after the discharge of sewage at the screen house had been discontinued, the results would show a great improvement in the condition of the water. If the discharge of sewage at the temporary outlet is discontinued in the near future, the Department will be pleased to make a further examination with reference to constructing a bathhouse at the location indicated, if you so request.

NORWOOD (NORWOOD CIVIC ASSOCIATION).

JAN. 18, 1915.

*To the Norwood Civic Association, Norwood, Mass., Mr. WALTER E. MARSHALL,
Business Secretary.*

GENTLEMEN: — In response to your request for an examination from time to time of the water of your swimming pool in Norwood and advice as to its condition, the Commissioner of Health has caused the pool to be examined and samples of the water to be analyzed.

The information presented shows that the pool is about 20 feet long by 60 feet wide with a depth of from 5 to 8 feet and has a capacity when filled to the usual level of about 75,000 gallons. It is used by about 500 persons per month, and regulations have been made relative to the taking of shower baths previous to entrance into the pool and to the sterilization of bathing suits.

In connection with the pool there is an apparatus for filtering the water consisting of three filters, which are washed apparently every other day, the waste water being discharged into the sewer.

The pool was filled originally with water from the Norwood town supply on Oct. 1, 1914, and about 5,000 gallons have since been added. The total quantity of water filtered each day amounts, judging from the information presented, to about 40,000 gallons, or about 55 per cent. of the capacity of the pool. The filtered water is treated with soda, alum and hypochlorite of lime and returned to the pool.

The results of the examination show that the condition of the water from a bacterial standpoint is much the same as that of other swimming pools in the State which have been examined by this Department. The filtration of the water is not very efficient, and the effluent of the filters is little better than the water supplied to them from the pool. The method of applying disinfectants is not accurate and, notwithstanding the filtration and disinfection of the water, large numbers of bacteria are present at times in the water of the pool.

It is probable that a better result might be obtained if hypochlorite were applied directly to the water of the pool each night after use of the pool for the day had ceased, instead of applying it to the water delivered to the filters.

Judging from the examinations of the various swimming pools that have come under the observation of the Department, a careful examination of those using the pools and an insistence upon their cleanliness and health seems to be the best method of protecting, so far as practicable, the health of the bathers. This precaution is advisable in any

case, even though material improvement is made in the efficiency of the filters and the disinfection of the water. It is advisable, however, that a more efficient filtration be secured if possible and that a change be made in the method of disinfection of the water as herein suggested.

PEABODY.

MAY 12, 1915.

To the Board of Health, Peabody, Mass.

GENTLEMEN: — In response to your request for an examination of the clams taken from the Danvers River near Danversport, the Commissioner of Health has caused the flats indicated to be examined and samples of the clams to be analyzed.

The Danvers River in this region is grossly polluted by sewage and tannery waste, and analyses of twelve samples from this region showed that in every case the clams were grossly polluted and unfit for use as food.

The board of health of Danvers has been notified of the danger to the public health in the continued use of clams from this locality.

In view of the results found, it is necessary to prevent the taking of clams for food in this section of the Danvers River. It is not unlikely that other areas are also affected by the pollution of this river and, treating your application as a complaint under chapter 91, section 113, of the Revised Laws, the Department will investigate the extent of the polluted flats and determine the areas from which the taking of clams for food should be prohibited.

PITTSFIELD (COOLIDGE MEMORIAL HOSPITAL).

NOV. 29, 1915.

To Mr. A. W. SHAW, Office of Overseers of the Poor, Pittsfield, Mass.

DEAR SIR: — In response to your communication relative to the proposed plans for the Frederick Shurtleff Coolidge Memorial Tuberculosis Hospital at Pittsfield, the State Department of Health has caused the location of the proposed hospital to be examined by one of its engineers and has examined the general plans.

The location indicated is a point about half a mile northeast of the village of Barkerville, about 60 feet above the level of the southwest branch of the Housatonic River and a short distance south of the Pittsfield Anti-Tuberculosis Camp. There is at this point a small knoll and the hospital will be located on the southeasterly side of this knoll, though the upper floors will be above its top. The site is located well

away from the highways but is easily accessible from the electric car line from Pittsfield.

The plans provide for a building about 130 x 30 feet in plan and two stories in height. A cellar is to be constructed under all but the sleeping porches. Provision is made in the beginning for eight patients and one nurse, and four maids' rooms, one bath and a large unfinished room are to be provided in the attic.

The hospital is to be supplied with water from one of the city water mains which has been recently extended to this neighborhood and, while the elevation is considerable, it is probable that an adequate quantity of water can be obtained in this way.

The plan of sewage disposal provides for a digestion tank, so called, a siphon chamber, and some 1,600 feet of tile pipe, to be laid 2 feet below the surface of the ground in the area to the east of the hospital on ground sloping to a small brook running from Mud Pond to the river. The soil in this locality does not appear to be porous, but since the number of patients and attendants is not likely to exceed fifteen, it is probable that the plan of sewage disposal proposed will operate for a time without serious difficulty. If the population of the hospital is enlarged, provision will probably have to be made eventually for the construction of a sub-surface filter for the disposal of the sewage, the effluent from which can be discharged into the Housatonic River.

The location of the proposed hospital appears to be a satisfactory one for the purpose, and the provisions for water supply and sewerage, considering the small number of patients that is likely to be accommodated at this hospital in the beginning, appear to be adequate.

PLYMOUTH.

MAY 7, 1915.

To the Board of Health, Plymouth, Mass.

GENTLEMEN: — Some time ago, at your request, an examination was made of the Newfield Street marsh, so called, in Plymouth, the drainage of which was being considered at that time by the town.

The results of that examination showed that the marsh has an area of a little less than two acres, situated about 68 feet above sea level, and that there is a pool in the middle of the marsh having an area of about 3,800 square feet.

The information submitted indicated that this marsh had an objectionable odor in the summer season, and it is possible that it is also a breeding place for mosquitoes.

In view of these conditions, it seems important that this marsh be

either drained or filled so as to prevent injury to the health of the inhabitants of the neighborhood.

If the town has not yet decided to drain or fill the marsh and it is likely to remain in its present condition during the coming year, it should be carefully examined, and if objectionable conditions are found, measures should be taken to prevent injury to the health of the residents in the neighborhood until the matter of permanent improvement can again be considered by the town. This Department will be pleased to give you or the board of selectmen further advice in this matter if any further action is deemed necessary.

QUINCY.

AUG. 20, 1915.

TO MESSRS. FRANK F. TAYLOR, HARRY B. MCINTIRE, GEORGE W. MITCHELL and Others, *Quincy, Mass.*

GENTLEMEN: — In response to your petition for an examination of Wollaston Beach at the mouth of Sachem Brook, where you state there is an objectionable odor, the State Department of Health has caused the locality to be examined by its engineer and has considered the information presented.

The results of the examination show that Sachem Brook drains an area of about one square mile, of which 90 per cent. is within the limits of the city of Quincy. Sewers are extended quite generally through the watershed, and sewers have been provided in the immediate neighborhood of the brook at its outlet in practically all the streets which have thus far been developed, and there is no indication that the brook is polluted seriously by sewage. At North Central Street the water of the brook when examined recently had a high color due to contact with organic matter in swamps, a condition which would not be injurious to the health of those living along the banks of the stream.

In the lower part of its course, just above its mouth, the brook was originally a tidal estuary and its bottom is covered with mud. The stream is also considerably polluted by organic matter caused by the dumping of rubbish upon its banks at various places within its watershed. While the condition of the brook is not wholly satisfactory, however, nothing was noted in the course of this examination which would cause a nuisance in the neighborhood of its outlet. Near the mouth of Sachem Brook the stream is crossed by the Quincy Shore Boulevard of the Metropolitan Park System, and below this bridge a basin has been dredged for the use of yachts. In this basin seaweed

tends to accumulate and, unless removed from time to time, it decays and causes objectionable odors. Two yacht club houses have been constructed in this locality, the sewage from which is discharged directly into the water beneath the buildings. The beach in this region is used by a large number of people for bathing in the summer season, and the discharge of sewage from these buildings is a very objectionable method of disposal and probably injurious to health.

In view of these conditions the Department has communicated the matter to the authorities of the city of Quincy and has recommended that the yacht club sewage be disposed of into the sewers of the city of Quincy. A copy of these recommendations is enclosed herewith.

To the Board of Health, Quincy, Mass.

AUG. 20, 1915.

GENTLEMEN: — In response to a petition from certain residents in the neighborhood of the mouth of Sachem Brook along the Quincy Shore Boulevard, the State Department of Health has caused the locality to be examined by its engineer and finds that seriously objectionable conditions are caused in this neighborhood by the discharge of sewage from the yacht clubs directly into the water beneath the buildings. This beach is used to a large extent for bathing in the summer season, and there is no doubt that the present method of disposal of sewage from these buildings is a menace to the public health.

The sewers of the city of Quincy appear to be available for the disposal of this sewage, and it is recommended that connections be made with the Quincy sewers at the earliest practicable time and the further discharge of sewage into the water near this beach prevented.

SHERBORN (JACOB LANDER).

To Mr. JACOB LANDER, Sherborn, Mass.

JUNE 29, 1915.

DEAR SIR: — The State Department of Health has considered your application for the approval of the use of a barn and fixtures which have been constructed for the purpose of conducting a slaughtering business in the town of Sherborn and has caused the locality to be examined by one of the engineers of the Department.

The proposed slaughterhouse is to be located off Beaver Street, about half a mile southeast of the village of Framingham, close to low ground adjacent to Beaver Dam Brook, one of the feeders of Lake Cochituate, one of the sources of supply of the metropolitan water district.

It would be very difficult to maintain a slaughterhouse in this loca-

tion in such a manner as to prevent the creating of objectionable conditions and, in view of all the circumstances, the Department voted not to approve the use of the barn and fixtures in question for the purposes of a slaughterhouse.

SOUTHBOROUGH.

OCT. 26, 1915.

*To the Board of Health, Southborough, Mass., Mr. CHARLES F. CHOATE, Jr.,
Chairman.*

GENTLEMEN:— In accordance with a request from your board, the State Department of Health has caused an examination to be made of the Winchester property at Southborough to determine what changes are necessary to put it in a sanitary condition.

The buildings on this property consist of two wooden houses, to one of which there is a barn attached, and a small brick building containing two rooms.

The main building, which is three stories in height and which contains six rooms on the lower floor, five on the middle floor and two in the attic, is provided with but a single water closet with partial fixtures for two others. The building to the west, containing a store on the lower floor and eight rooms for dwelling purposes on the second floor, is provided with two water closets and two sinks. The toilet rooms in the two large houses are located near the center of the house in each case and have no method of ventilation, which is a violation of present-day building laws. Changes should be made in these buildings so that a toilet room will be provided for each family that occupies them, and each toilet room should have an outside window. The toilet room in the small brick building is provided with a suitable window.

All the litter and refuse should be removed from the floors and cellars of the larger buildings and these buildings should be thoroughly cleaned. In addition to removing the refuse from the buildings, cleaning them thoroughly and providing proper fixtures, the buildings should be properly painted. The small brick building when examined appeared to be in satisfactory condition.

The only water supplies available on these premises are two wells, both of which are grossly polluted so that the water is unfit for domestic use. It is impracticable to obtain water of suitable quality for domestic use upon these premises under existing conditions, and if the buildings are again occupied water for domestic purposes will have to be obtained from some suitable source elsewhere. The water from the wells might be used for the flushing of water closets, provided no

connections are maintained through which the water could be used for drinking or other domestic purposes.

The sewage of these buildings was formerly disposed of in cesspools in the rear of the buildings, whence it overflowed upon the ground, a portion of it finding its way into the barn cellar, the condition of which was made very objectionable. Since the buildings were vacated, the effects of this nuisance have practically disappeared. It is probable, however, that if the existing cesspools were again used objectionable conditions would again occur.

The best practicable plan of disposing of the sewage of the main buildings, and probably the only plan under which a nuisance can be avoided, will be to collect the sewage in a suitable tank built in two compartments so arranged that the sewage will enter one compartment and will thence overflow to the second compartment. Each compartment should be approximately 10 feet in diameter and 6 feet in depth. The contents of the tank should be removed as often as necessary in odorless excavator carts. The frequency of cleaning the tank will, of course, depend upon the number of inhabitants in the buildings. Assuming that the property will not be occupied by more than twenty persons, which would be the approximate capacity of the present buildings, exclusive of the small brick building, under modern building laws, the tank would probably require cleaning about every other week. If the number of inhabitants in the two larger buildings were restricted to ten, it is possible that the sewage could be disposed of without nuisance in cesspools upon the property from which a part of it would leach away, though the contents would doubtless still require removal at intervals, especially in periods of more than average rainfall. The sewage of the small brick building could probably be disposed of in an ordinary cesspool in the rear of the house since the number of occupants of this building would necessarily be very small.

SOUTHWICK (PROPOSED SCHOOL FOR FEEBLE-MINDED).
(See BELCHERTOWN.)

WATERTOWN.

DEC. 9, 1915.

To the Board of Health, Watertown, Mass., Mr. CHARLES F. HORAN, Agent.

GENTLEMEN: — The State Department of Health received from you on Dec. 7, 1915, the following application for advice relative to permitting the keeping of about 3,000 horses at the Union Stock Yards in Watertown.

Recently there has been filed at the office of the local board of health an application, made in the name of the Boston and Maine Railroad company, for a license or permit to keep or stable 3,000 horses at the Union Stock Yards in Watertown. Following a public hearing on the matter, the Board of Health — feeling that the keeping of such a large number of horses might become a nuisance — denied the application.

The Boston and Maine company has later filed a petition for reconsideration, and this petition is at present being considered by the local board.

The Board of Health has instructed me to ask the advice of the State Department of Health in this matter, and request that — if possible — a sanitary engineer from the department visit the yards and advise us as to the possibility of having the yards used for 3,000 horses (the yards being without any drainage) without it becoming a nuisance. . . .

In accordance with your request, the State Department of Health has caused the yards and their surroundings to be examined by its engineer and has considered the information relating thereto.

It is understood that the yards are to be used simply as a resting place for horses which are being transported from Chicago to be shipped on vessels from Boston Harbor to foreign countries, that the horses will be in the yards only for a few hours at a time, and that the number of animals present will vary greatly from day to day, though the yards will be in continuous use. As the horses to be handled have always lived in the open, it is not considered necessary to provide bedding or any other shelter than the open sheds, and the process of removing manure will, consequently, be a simple one. The yards have been used for cattle for many years, though in lesser numbers in recent years than formerly, and it is obvious that the drainage of the yards has hitherto been satisfactory. An examination of the soil in many parts of the yards shows that it is generally porous and easily drained, and to facilitate the further ready drainage of these yards the area to be occupied by the horses has recently been covered with engine ashes or cinders to a depth of several inches.

The Department is informed that the yards were provided with a drainage system several years ago which appears to be operating satisfactorily at the present time, judging from such examinations as it has been practicable to make. It is possible that the system is more or less obstructed in one or two places and at the culverts through which the drainage passes beneath Arsenal Street and Charles River Road. The drain discharges ultimately into the Charles River.

With the use of the yards for horses as proposed, the amount of drainage requiring disposal may be somewhat greater at times than it has been in past years, due to the fact that the yards are now being

pipcd for water and that in the process of watering horses some of the water may be wasted. The amount of such waste, however, is unimportant as compared with the rainfall that the system now removes.

It is of course necessary that the drainage system be properly maintained, and in connection with the proper maintenance of the drainage system it is essential of course that the gratings over the entrances to the drains should be kept free from obstruction.

As a result of the examinations made by its engineers, this Department advises you that there is, in its opinion, no danger of injury to the public health nor other reasonable objection to the use of these yards for the purpose proposed.

WINCHESTER.

SEPT. 21, 1915.

To the Board of Health, Winchester, Mass., C. J. ALLEN, M.D., Secretary.

GENTLEMEN:— On June 4, 1915, there was filed with the State Department of Health a communication from your board giving the vote of the town meeting and the results of the investigation of a town committee relative to the pollution of the Aberjona River and its tributaries.

In their report they mention first that "At the Beggs and Cobb tanning plant there is a large amount of material leaking from vats and leaching from the contents of the tanning pits after they have been dumped outside that eventually finds its way into the stream, and measures should be taken to control this contamination." The Beggs and Cobb tannery have, in accordance with the recommendations of this Department, discontinued dumping the contents of their tanning pits and settling tanks in such a way that they are in danger of being washed into the stream. A great amount of material that has previously been dumped by this company upon the ground in the neighborhood of their works is affected by the rainfall and there is necessarily a leaching from this deposit towards neighboring streams. We are unable to find, however, that there is any direct pollution of the stream from these works such as would come within the provisions of chapter 291 of the Acts of 1911.

Mention is also made by the committee of a settling basin at the gelatine factory near Cross Street, where at one place a channel affords free access between the basin and the river. Recent examinations show that this channel is very small, that there is very little flow through it, and the waste found flowing in it was not of such a character as

to noticeably pollute the stream into which it discharged. The two drains mentioned in your letter are not now discharging offensive waste into the stream.

The report also refers to the discharge of oil in condensing water into the stream and also acid from the chemical works at North Woburn. While the oil affects the appearance of the stream, it does not appear to create at any point a nuisance within the meaning of the act. There is also no indication that the discharge of acid drainage from the chemical works into the stream, though objectionable for certain reasons, is injurious to the public health or tends to create a public nuisance.

This Department has issued notice and directed the discontinuance of the discharge of waste matters into the stream at points where it found such conditions existing, and apparently most of these recommendations have been faithfully carried out. Only two cases have been discovered during the past summer where foul waste has been permitted to enter the river or its tributaries, and these were apparently temporary conditions. Nevertheless, the parties have been notified that such discharge must cease, and the objectionable conditions have been remedied.

In our recent examinations we have found nothing in the river waters indicating direct pollution of the stream or its tributaries at the present time. There is, however, considerable indirect pollution of these waters which seems inevitable under the circumstances. There are numerous tanneries in this valley in the neighborhood of which large quantities of tannery waste have been deposited for many years in the past, and the rainfall undoubtedly takes up matters from these deposits which find their way eventually to the streams, partly no doubt after more or less purification by passing through the ground. It is impracticable to prevent or remove this pollution. There is also the pollution of the streams that is inevitable in a densely populated valley and which comes from the cultivation of fields and gardens, from the washings of streets, yards and courts, from public dumps, and from the dumping of refuse and waste matter elsewhere, some of which is carried into the streams. A considerable amount of such pollution takes place in the valley of the Aberjona River and makes some of the streams unsightly and objectionable, not only after heavy rains but at other times.

In some cities where streams flow through populous districts lands have been taken along their banks and their channels greatly improved. Several years ago the town of Winchester made plans for improving a portion of the Aberjona River which have thus far not

been carried out. It seems essential, in the opinion of the Department, in order to maintain the streams in Winchester in a satisfactory sanitary condition, that the control of their channels should be secured by the town and that they should be improved to such an extent that they can be kept free from debris and the sources of pollution more readily detected.

This letter is sent your board in order to inform you as to the conditions that have been found by this Department to exist in the streams in the valley of the Aberjona River. The Department will continue its efforts to secure the prevention of the pollution of these streams, so far as its powers extend under existing laws, but it is evident that something further is necessary in order to maintain the streams in a more satisfactory condition than at the present time. This Department is prepared to co-operate with your board or with any of the authorities of the valley at any time in efforts to secure further improvement of the streams in this valley.

WINTHROP.

MAY 13, 1915.

To Hon. EDGAR H. WHITNEY, *House of Representatives, State House, Boston, Mass.*

DEAR SIR:— In response to your request, the State Department of Health has caused a further examination to be made of the flats on the westerly side of Winthrop in the neighborhood of Chelsea Point and samples of the clams to be analyzed.

The results show that the clams all about this point are badly polluted and contain large numbers of bacteria. They are unsafe to use for food. A copy of the results of analyses of samples taken both in the years 1914 and 1915 is enclosed herewith, together with a map which will show the location in which the samples were taken.

WOBURN.

SEPT. 21, 1915.

To the Board of Health, Woburn, Mass.

GENTLEMEN:— Your communication of July 14, 1915, stating that on June 9, 1915, you notified all factories in Woburn warning them against violations of chapter 235 of the Acts of the year 1907 by allowing polluting matter to flow into Russell Brook or its tributaries, was duly received by the State Department of Health.

This Department has caused examinations of the streams in Woburn to be made during the past summer and has found two cases of pollu-

tion, one of which was caused by a tannery, and has given notice that prosecution will follow any further discharge of such wastes into any of the streams. Aside from the pollutions already noted, the Department has not found any other cases of serious direct pollution of the streams from the tanneries or other works in the city of Woburn. Nevertheless, the streams show evidence of considerable pollution, which, in view of the conditions in this valley, it is impracticable to wholly prevent. In the course of many years large quantities of organic matter, chiefly from the tanneries, have been deposited upon the ground at many places in this valley, and the natural effect of the rainfall is to carry matters from these deposits, partly in solution and partly in suspension, into the streams. The prevention of the pollution of the streams in this manner appears to be impracticable under present conditions. Furthermore, the streams receive much pollution from the cultivation of fields and gardens, the washings of streets and yards, the dumping of refuse, and other serious pollutions which are inevitable in a populous territory such as that in Woburn drained by Russell Brook and its tributaries.

In some places in the city of Woburn the streams have been covered and these channels are not in a condition for satisfactory inspection, but inspection of the open channels in the thickly settled portions of the city shows that, in addition to pollution from the causes already mentioned, these channels are rendered unsightly and objectionable by the presence of refuse of various kinds, including tin, old iron and other debris, which have collected upon their banks and bottoms.

It is impracticable, in the opinion of the Department, to maintain these streams in a wholly satisfactory condition until their channels have been improved to such an extent that they can be kept free from debris and pollution can be more readily detected. Such improvements have been made in the channels of streams in thickly populated districts in other cities, and the conditions have become such in Woburn that an improvement of the natural drainage channels in the populous districts at least is very desirable.

This Department will continue to make every effort to prevent the pollution of streams in the valley of the Aberjona River and its tributaries to the extent of its powers under existing laws, and will be pleased to co-operate with your board and any of the authorities of towns in the valley in an effort to secure further improvement in the channels of the streams which will make it possible to maintain them in a much better sanitary condition than is practicable at the present time.

WOBURN (F. C. PARKER & SON COMPANY).

SEPT. 10, 1915.

TO F. C. PARKER & SON COMPANY, *Woburn, Mass.*

GENTLEMEN:—The recent examination of your premises has shown that manufacturing wastes were overflowing from them into Russell Brook in sufficient quantities and of such strength as to seriously pollute the brook.

On May 14, 1913, you were notified, under the authority of chapter 291 of the Acts of the year 1911, to desist from such pollution.

The matter is again brought to your attention in order that you may take such action in the near future as will prevent further pollution of the brook. Otherwise it will be the duty of the State Department of Health to take action under the provisions of the act above quoted, a copy of which is enclosed herewith. Your special attention is called to the penalty clause, section 4.

WOBURN (WOBURN GAS LIGHT COMPANY).

SEPT. 10, 1915.

To the Woburn Gas Light Company, Woburn, Mass.

GENTLEMEN:—An examination of Russell Brook flowing past your works in Woburn shows evidence that it is polluted by gas wastes to such an extent as to impart an offensive odor to the brook at times below your works.

You are notified that the pollution of this brook by wastes from your works is contrary to the provisions of chapter 291 of the Acts of the year 1911 and you are advised to take action without delay to prevent further pollution of the brook by these wastes.

EXAMINATION OF PUBLIC WATER SUPPLIES.

The usual chemical analyses of the principal sources of public water supply in the State have been made during the year and are presented in the two following tables, the first of which contains averages of analyses of the surface-water supplies and the second the averages of analyses of the ground-water supplies.

Averages of Chemical Analyses of Surface-water Sources for the Year 1915.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evaporation.	AMMONIA.			Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				Free.	Total.	Suspended.		Nitrates.	Nitrites.		
Metropolitan Water District.	Wachusett Reservoir, upper end.	.26	3.59	.0022	.0168	.0028	.30	.0026	.0000	.41	1.0
	Wachusett Reservoir, lower end.	.11	3.22	.0023	.0138	.0022	.32	.0023	.0000	.24	1.0
	Sudbury Reservoir,	.14	3.87	.0027	.0193	.0042	.36	.0027	.0000	.25	1.3
	Framingham Reservoir No. 3.	.13	3.66	.0036	.0191	.0034	.37	.0022	.0000	.27	1.3
	Hopkinton Reservoir,	.63	4.11	.0030	.0257	.0033	.39	.0022	.0000	.66	1.2
	Ashland Reservoir,	.58	4.21	.0034	.0277	.0047	.37	.0025	.0000	.67	1.3
	Framingham Reservoir No. 2.	.91	5.60	.0060	.0320	.0053	.46	.0041	.0000	.81	1.4
	Lake Cochituate, . .	.19	6.12	.0068	.0238	.0052	.66	.0029	.0000	.39	2.4
	Chestnut Hill Reservoir,	.15	3.71	.0020	.0163	.0029	.35	.0036	.0000	.26	1.4
	Weston Reservoir, . .	.12	3.78	.0021	.0165	.0031	.38	.0027	.0000	.25	1.3
	Spot Pond, ...	.06	3.73	.0023	.0167	.0028	.40	.0004	.0000	.22	1.4
	Tap in State House, .	.15	3.68	.0015	.0151	.0021	.38	.0046	.0000	.25	1.4
	Tap in Revere, . . .	.08	3.79	.0013	.0145	.0017	.39	.0014	.0000	.18	1.5
Abington, ...	Tap in Quincy, . . .	.11	3.68	.0012	.0139	.0018	.39	.0059	.0000	.23	1.4
	Big Sandy Pond, . . .	.05	3.60	.0023	.0175	.0039	.73	.0010	.0000	.10	0.8
Adams, ...	Little Sandy Pond, . .	.00	4.77	.0044	.0178	.0063	1.64	.0010	.0000	.12	0.7
	Dry Brook, ...	.35	6.58	.0014	.0145	.0023	.14	.0050	.0000	.59	3.5
	Bassett Brook, . . .	.02	3.56	.0013	.0070	.0015	.13	.0047	.0000	.10	1.8
Amherst, ...	Amethyst Brook large reservoir.	.61	4.00	.0032	.0210	.0061	.20	.0023	.0000	.64	0.8
	Amethyst Brook small reservoir.	.26	3.71	.0018	.0133	.0014	.20	.0040	.0000	.33	0.8
	Lower Reservoir, . . .	.50	3.99	.0028	.0128	.0013	.21	.0053	.0000	.45	1.0

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				Free.	ALBUMINOID.			Nitrates.	Nitrites.		
					Total.	Sus- pended.					
Andover, . . .	Haggett's Pond, . . .	.12	3.82	.0037	.0185	.0012	.43	.0012	.0000	.24	1.4
Ashburnham, . . .	Upper Naukeag Lake, . . .	.02	2.58	.0015	.0097	.0017	.17	.0015	.0000	.12	0.7
Ashfield, . . .	Bear Swamp Brook, . . .	.33	4.87	.0016	.0143	.0012	.16	—	—	—	2.6
Athol, . . .	Phillipston Reservoir, . . .	.45	4.12	.0139	.0407	.0118	.21	.0037	.0000	.78	0.9
	Buckman Brook Reser- voir.	.35	4.01	.0081	.0328	.0108	.17	.0035	.0000	.59	0.9
	Inlet of Filter, . . .	.78	5.31	.0093	.0321	.0067	.17	.0049	.0000	1.09	1.3
	Outlet of Filter, . . .	.63	5.30	.0043	.0213	—	.19	.0076	.0000	.98	1.5
Barre, . . .	Reservoir, . . .	.17	3.65	.0070	.0264	.0063	.24	.0020	.0000	.42	1.1
Blandford, . . .	Freeland Brook, . . .	.05	2.90	.0004	.0055	.0009	.22	.0225	.0000	.04	0.9
Brockton, . . .	Silver Lake, . . .	.10	3.53	.0034	.0141	.0022	.67	.0057	.0000	.22	0.6
Cambridge, . . .	Upper Hobbs Brook Res- ervoir.	.70	7.13	.0090	.0403	.0054	.51	.0094	.0000	.68	2.5
	Lower Hobbs Brook Res- ervoir.	.12	7.13	.0046	.0294	.0053	.55	.0029	.0000	.34	2.9
	Stony Brook Reservoir,	.55	7.17	.0041	.0309	.0054	.62	.0110	.0000	.54	2.7
	Fresh Pond, . . .	.24	6.65	.0111	.0313	.0101	.66	.0138	.0001	.39	2.9
Cheshire, . . .	Thunder Brook, . . .	.00	5.10	.0004	.0047	.0005	.13	.0073	.0000	.07	3.3
	Kitchen Brook, . . .	.01	5.07	.0019	.0073	.0011	.13	.0043	.0000	.08	3.1
Chester, . . .	Austin Brook, . . .	.12	3.17	.0012	.0108	.0024	.15	.0025	.0000	.23	1.4
	Horn Pond, . . .	.20	3.62	.0017	.0128	.0023	.14	.0023	.0000	.38	1.6
Chicopee, . . .	Morton Brook, . . .	.07	3.85	.0012	.0062	.0004	.19	.0035	.0000	.08	0.9
	Cooley Brook, . . .	1.04	4.03	.0051	.0247	.0045	.18	.0030	.0000	.39	1.4
Colrain, . . .	McClellan Reservoir, . . .	.05	6.95	.0009	.0094	.0011	.18	.0057	.0000	.13	4.1
Concord, . . .	Nagog Pond, . . .	.05	2.85	.0018	.0147	.0010	.37	.0012	.0000	.15	0.5
Dalton, . . .	Egypt Brook Reservoir,	.28	3.72	.0020	.0127	.0013	.11	.0103	.0000	.50	1.3
	Cady Brook, . . .	.40	4.91	.0014	.0149	.0016	.09	.0033	.0000	.55	2.0
Danvers, . . .	Middleton Pond, . . .	.50	5.87	.0025	.0222	.0032	.45	.0012	.0000	.58	1.9
Deerfield (South),	Roaring Brook, . . .	.07	6.20	.0026	.0090	.0015	.19	.0025	.0000	.13	3.5
Egremont (South),	Goodale Brook, . . .	.01	3.78	.0005	.0033	.0002	.12	.0015	.0000	.05	2.3
Fall River, . . .	North Watuppa Lake, . . .	.14	4.30	.0034	.0223	.0047	.66	.0021	.0000	.35	1.1
Falmouth, . . .	Long Pond, . . .	.00	3.33	.0027	.0126	.0018	.95	.0012	.0000	.09	0.4
Fitchburg, . . .	Meetinghouse Pond, . . .	.11	3.14	.0086	.0204	.0026	.23	.0012	.0000	.27	0.9
	Scott Reservoir, . . .	.16	3.01	.0075	.0219	.0055	.21	.0022	.0000	.33	0.6
	Wachusett Lake, . . .	.11	2.62	.0065	.0204	.0039	.19	.0020	.0000	.26	0.7
	Falulah Brook, . . .	.22	3.16	.0063	.0146	.0023	.20	.0020	.0000	.34	0.6

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				Free.	ALBUMINOID.			Nitrates.	Nitrites.		
					Total.	Sus- pended.					
Gardner, . . .	Crystal Lake, . . .	.08	4.75	.0023	.0193	.0032	.31	.0022	.0000	.19	1.8
Gloucester, . . .	Dike's Brook Reservoir,	.28	4.35	.0037	.0189	.0033	1.01	.0012	.0000	.27	0.5
	Wallace Reservoir, . . .	.44	4.84	.0061	.0246	.0063	1.18	.0007	.0000	.39	0.8
	Haskell Brook Reservoir,	.31	4.41	.0033	.0168	.0025	.97	.0010	.0000	.22	0.5
	Great Barrington,	East Mountain Reservoir,	.13	5.55	.0076	.0156	.0041	.14	.0030	.0000	.25
	Green River, ...	.01	8.64	.0021	.0064	.0008	.16	.0137	.0000	.05	6.1
Great Barrington (Housatonic).	Long Pond, ...	.05	8.63	.0054	.0243	.0029	.15	—	—	—	5.8
Greenfield, . . .	Glen Brook Upper Reser- voir.	.06	5.27	.0036	.0098	.0022	.19	.0050	.0000	.14	3.1
	Glen Brook Lower Reser- voir.	.06	5.43	.0035	.0101	.0019	.20	.0057	.0000	.12	3.2
Hadley, . . .	Hart's Brook Reservoir,	.09	3.87	.0011	.0062	.0008	.23	.0020	.0000	.09	1.5
Hatfield, . . .	Running Gutter Brook Reservoir.	.07	4.65	.0030	.0070	.0013	.22	.0175	.0000	.11	2.0
Haverhill, . . .	Johnson's Pond, . . .	.17	5.43	.0024	.0216	.0033	.55	.0017	.0000	.30	2.3
	Crystal Lake, ...	.16	4.16	.0018	.0203	.0026	.39	.0020	.0000	.31	1.2
	Kenoza Lake, ...	.19	5.12	.0019	.0201	.0028	.50	.0014	.0000	.39	2.0
	Lake Saltonstall, . . .	.09	7.13	.0027	.0184	.0018	.71	.0017	.0000	.22	3.0
	Lake Pentucket, . . .	.14	5.04	.0025	.0192	.0029	.46	.0022	.0000	.34	2.2
	Millvale Reservoir, . .	.69	5.85	.0040	.0268	.0040	.40	.0022	.0000	.57	2.0
Hingham, . . .	Accord Pond, ...	.19	4.34	.0029	.0180	.0031	.75	.0022	.0000	.34	1.0
Hinsdale, . . .	Reservoir, ...	.29	2.62	.0107	.0165	.0027	.10	.0064	.0000	.26	0.9
Holden, . . .	Muschopauge Lake, . .	.04	3.11	.0017	.0133	.0020	.34	.0017	.0000	.15	0.9
Holyoke, . . .	Whiting Street Reservoir,	.07	5.08	.0043	.0178	.0032	.23	.0022	.0000	.17	2.3
	Fomer Reservoir, . . .	.36	4.05	.0021	.0185	.0037	.17	.0042	.0000	.38	1.3
	Wright and Ashley Pond,	.10	5.04	.0034	.0192	.0034	.18	.0017	.0000	.24	2.5
	High Service Reservoir,	.11	4.22	.0043	.0232	.0040	.19	.0022	.0000	.30	1.5
	White Reservoir, . . .	.28	3.99	.0075	.0259	.0059	.17	.0032	.0000	.41	1.4
	Hudson, . . .	Gates Pond, ...	.07	3.62	.0043	.0203	.0041	.25	.0022	.0000	.21
	Fosgate Brook, ...	.43	13.19	.0275	.0291	.0082	.27	.0177	.0002	.58	5.7
Huntington, . .	Cold Brook Reservoir, .	.20	3.34	.0006	.0085	.0010	.14	.0013	.0000	.25	1.0
Ipswich, . . .	Dow's Brook Reservoir,	.39	6.30	.0052	.0239	.0051	.86	.0064	.0000	.51	2.2
Lawrence, . . .	Merrimack River, fil- tered.	.23	5.77	.0052	.0076	—	.46	.0350	.0001	.40	1.7
Lee, ...	Codding Brook Upper Reservoir.	.14	3.90	.0010	.0091	.0004	.14	.0040	.0000	.14	1.7
	Codding Brook Lower Reservoir.	.13	5.00	.0012	.0117	.0022	.14	.0025	.0000	.14	2.1
	Basin Pond Brook, . .	.65	4.15	.0028	.0198	.0024	.11	.0035	.0000	.58	1.4

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				Free.	ALBUMINOID.			Nitrates.	Nitrites.		
					Total.	Sus- pended.					
Lenox, . . .	Reservoir, . . .	.05	7.35	.0031	.0087	.0011	.11	.0037	.0000	.12	5.2
Leominster, . . .	Morse Reservoir, . . .	.22	2.94	.0132	.0252	.0069	.20	.0042	.0000	.32	0.4
	Haynes Reservoir, . . .	.32	3.11	.0284	.0494	.0194	.17	.0017	.0000	.42	0.5
	Fall Brook Reservoir, . . .	.12	2.55	.0032	.0181	.0042	.22	.0017	.0000	.25	0.5
	Sandy Pond, . . .	.04	4.86	.0030	.0193	.0034	.40	.0020	.0000	.13	1.8
Longmeadow, . . .	Cooley Brook, . . .	.08	4.94	.0069	.0086	.0015	.27	.0095	.0001	.08	2.4
Lynn, . . .	Birch Reservoir, . . .	.23	5.40	.0074	.0252	.0056	.73	.0020	.0000	.35	2.0
	Walden Reservoir, . . .	.47	6.91	.0086	.0278	.0048	.85	.0040	.0000	.61	2.6
	Hawkes Reservoir, . . .	.79	8.47	.0093	.0393	.0065	.92	.0025	.0000	.94	3.3
	Saugus River, . . .	.96	10.06	.0107	.0444	.0095	1.12	.0075	.0001	.88	4.3
Manchester, . . .	Round Pond, . . .	1.19	6.91	.0043	.0347	.0054	1.01	.0017	.0000	.82	1.4
	Gravel Pond, . . .	.09	4.47	.0024	.0172	.0019	.95	.0012	.0000	.16	1.1
Marlborough, . . .	Lake Williams, . . .	.09	4.62	.0039	.0194	.0029	.52	.0040	.0001	.22	1.6
	Millham Brook Reser- voir, . . .	.52	5.54	.0067	.0301	.0052	.43	.0072	.0000	.46	1.7
Maynard, . . .	White Pond, . . .	.34	3.37	.0013	.0173	.0017	.29	—	—	—	1.1
Milford, . . .	Charles River, filtered, *	.28	6.56	.0013	.0087	—	.38	.0064	.0000	.25	3.0
Montague, . . .	Lake Pleasant, . . .	.06	2.89	.0018	.0139	.0032	.18	.0018	.0000	.12	0.7
Nantucket, . . .	Wannacomet Pond, . . .	.06	6.63	.0040	.0153	.0034	2.21	.0010	.0000	.14	1.3
New Bedford, . . .	Little Quittacas Pond, . . .	.29	4.46	.0037	.0214	.0034	.62	.0012	.0000	.51	1.0
	Great Quittacas Pond, . . .	.38	4.34	.0035	.0219	.0033	.62	.0015	.0000	.59	0.9
North Adams, . . .	Notch Brook Reservoir, . . .	.06	7.31	.0025	.0073	.0008	.11	.0023	.0000	.12	5.8
	Broad Brook, . . .	.14	4.01	.0019	.0079	.0011	.11	.0046	.0000	.29	2.0
	Beaman Reservoir, . . .	.06	7.33	.0031	.0135	.0032	.12	.0028	.0000	.13	5.0
Northampton, . . .	Middle Reservoir, . . .	.27	4.02	.0028	.0179	.0033	.16	.0032	.0000	.37	1.8
	Mountain Street Reser- voir, . . .	.09	3.73	.0011	.0111	.0023	.14	.0020	.0000	.19	1.7
	West Brook, . . .	.12	4.55	.0008	.0094	.0020	.14	.0035	.0000	.17	1.9
North Andover, . . .	Great Pond, . . .	.17	5.07	.0027	.0191	.0036	.52	.0015	.0000	.21	1.9
Northborough, . . .	Lower Reservoir, . . .	.72	4.81	.0051	.0281	.0035	.31	.0022	.0000	.87	1.1
Northbridge, . . .	Cook Allen Reservoir, . . .	.31	3.35	.0034	.0166	.0040	.27	.0050	.0000	.25	0.5
North Brookfield, . . .	Doane Pond, . . .	.39	3.50	.0069	.0315	.0062	.21	.0020	.0000	—	1.2
	North Pond, . . .	.47	3.70	.0081	.0376	.0131	.22	.0015	.0000	.47	0.9
Northfield, . . .	Reservoir, . . .	.20	3.25	.0008	.0087	.0007	.16	.0017	.0000	.37	1.0
Norwood, . . .	Buckmaster Pond, . . .	.12	4.56	.0119	.0208	.0056	.60	.0094	.0000	.20	1.4

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				Free.	ALBUMINOID.			Nitrates.	Nitrites.		
					Total.	Sus- pended.					
Orange,	Reservoir,	.09	3.18	.0011	.0057	.0008	.16	.0010	.0000	.13	0.9
Palmer,	Lower Reservoir,	.21	3.52	.0039	.0138	.0027	.17	.0020	.0000	.19	0.9
Peabody,	Brown's Pond,	.18	4.61	.0050	.0202	.0030	.97	.0048	.0000	.27	1.3
	Spring Pond,	.29	6.00	.0061	.0213	.0047	.79	.0077	.0000	.37	2.2
Pittsfield,	Suntaug Lake,	.05	5.38	.0088	.0215	.0031	1.02	.0022	.0000	.16	2.5
	Ashley Lake,	.20	3.27	.0041	.0170	.0016	.11	.0045	.0000	.32	1.6
	Ashley Brook,	.18	6.61	.0031	.0116	.0016	.12	.0037	.0000	.31	4.6
	Hathaway Brook,	.01	9.41	.0008	.0053	.0004	.14	.0120	.0000	.12	7.3
	Mill Brook,	.42	5.74	.0041	.0161	.0018	.14	.0225	.0000	.57	2.7
	Sacket Brook,	.15	6.90	.0011	.0069	.0002	.13	.0081	.0000	.20	4.9
	Farnham Reservoir,	.66	5.60	.0046	.0244	.0037	.13	.0220	.0000	.89	2.1
Plymouth,	Little South Pond,	.01	2.69	.0025	.0220	.0048	.69	.0010	.0000	.10	0.2
	Great South Pond,	.00	2.81	.0032	.0179	.0042	.71	.0007	.0000	.10	0.2
Randolph,	Great Pond,	.39	5.61	.0035	.0217	.0021	.81	.0027	.0000	.59	1.5
Rockport,	Cape Pond,	.21	14.00	.0045	.0245	.0074	5.47	.0015	.0000	.20	2.6
Russell,	Black Brook,	.23	3.82	.0011	.0108	.0009	.16	.0047	.0000	.22	1.4
Salem,	Wenham Lake,	.36	7.54	.0117	.0316	.0088	1.02	.0115	.0000	.45	2.7
	Longham Reservoir,	1.28	8.53	.0114	.0498	.0157	1.09	.0176	.0000	1.15	2.2
Shelburne,	Fox Brook,	.04	5.30	.0006	.0049	.0011	.11	.0025	.0000	.09	3.0
Southbridge,	Hatchet Brook Reservoir No. 3.	.22	3.58	.0048	.0207	.0035	.21	.0029	.0000	.30	0.9
	Hatchet Brook Reservoir No. 4.	.26	3.04	.0057	.0221	.0046	.20	.0019	.0000	.34	0.7
South Hadley,	Leaping Well Reservoir,	.09	3.53	.0060	.0298	.0153	.21	.0062	.0000	.09	0.9
	Buttery Brook Reser- voir.	.08	4.29	.0083	.0115	.0029	.34	.0267	.0000	.04	1.1
Spencer,	Shaw Pond,	.03	2.57	.0010	.0136	.0012	.22	.0015	.0000	.12	0.9
Springfield,	Westfield Little River, filtered.	.17	4.01	.0015	.0093	—	.16	.0051	.0000	—	1.2
Stockbridge,	Lake Averie,	.12	7.71	.0030	.0232	.0058	.12	.0042	.0000	.23	5.4
Stoughton,	Muddy Pond Brook,	.14	3.76	.0006	.0087	.0017	.43	.0057	.0000	.20	1.0
Taunton,	Assawompsett Pond,	.20	4.01	.0034	.0198	.0027	.61	.0007	.0000	.41	0.9
	Elder's Pond,	.09	3.87	.0026	.0197	.0027	.62	.0010	.0000	.31	0.8
Wakefield,	Crystal Lake,	.28	5.64	.0092	.0291	.0044	.84	.0026	.0000	.39	2.1
Wareham (Onset),	Jonathan Pond,	.00	2.69	.0014	.0098	.0010	.70	.0007	.0000	.06	0.3
Wayland,	Snake Brook Reservoir,	1.26	5.98	.0087	.0404	.0038	.43	.0030	.0000	1.00	1.6
Westfield,	Montgomery Reservoir,	.61	3.51	.0056	.0264	.0033	.17	.0017	.0000	.74	0.5

Averages of Chemical Analyses of Surface-water Sources, etc. — Concluded.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evapo- ration.	AMMONIA.			Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				Free.	ALBUMINOID.			Nitrates.	Nitrites.		
					Total.	Sus- pended.					
Westfield— <i>Con.</i> , .	Tekoa Reservoir, . . .	.42	3.53	.0040	.0174	.0030	.16	.0025	.0000	.47	0.5
	Tillotson Brook Reservoir, .	.10	3.23	.0014	.0099	.0015	.18	.0107	.0000	.14	0.6
West Springfield, .	Darby Brook Reservoir, .	.18	5.43	.0083	.0273	.0127	.32	.0070	.0000	.23	2.8
	Bear Hole Brook, filtered, .	.03	7.30	.0008	.0059	—	.24	.0045	.0000	—	4.5
Weymouth, . . .	Great Pond, ...	.35	4.46	.0040	.0172	.0012	.70	.0017	.0000	.55	1.0
Williamsburg, .	Reservoir, ...	.14	4.79	.0014	.0090	.0010	.16	.0005	.0000	.22	1.7
Winchester, . . .	North Reservoir, . . .	.08	4.07	.0051	.0172	.0021	.48	.0009	.0000	.17	1.5
	South Reservoir, . . .	.08	4.02	.0031	.0170	.0027	.44	.0016	.0000	.14	1.6
	Middle Reservoir, . . .	.15	3.76	.0056	.0268	.0040	.47	.0021	.0000	.25	1.4
Worcester, . . .	Bottomly Reservoir, . .	.27	5.68	.0050	.0230	.0023	.23	.0177	.0000	.42	2.2
	Kent Reservoir, ...	.16	4.24	.0028	.0195	.0035	.30	.0042	.0000	.30	1.6
	Leicester Reservoir, . .	.20	3.96	.0051	.0183	.0023	.28	.0047	.0000	.35	1.3
	Mann Reservoir, ...	.12	4.04	.0026	.0167	.0021	.25	.0070	.0000	.28	1.5
	Upper Holden Reservoir, .	.15	2.94	.0009	.0096	.0013	.27	.0032	.0000	.21	0.7
	Lower Holden Reservoir, .	.12	3.00	.0024	.0163	.0029	.25	.0019	.0000	.25	0.9

Averages of Chemical Analyses of Ground-water Sources for the Year 1915.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS —		Hardness.	Iron.
				Free.	Albu- minoid.		Nitrates.	Nitrites.		
Acton, ...	Tubular wells, ...	00	9.17	.0006	.0023	.70	.1567	.0000	3.6	.007
Adams, ...	Tubular wells, ...	06	3.62	.0012	.0058	.11	.0030	.0000	2.0	.007
Amesbury, ...	Tubular wells, ...	31	19.00	.0028	.0053	.59	.0030	.0000	9.4	.290
Ashland, ...	Tubular wells, ...	00	4.22	.0004	.0017	.43	.0045	.0002	1.2	.006
Attleboro, ...	Large well, ...	03	4.88	.0006	.0061	.58	.0217	.0000	1.8	.009
Avon, ...	Wells, ...	00	5.70	.0005	.0018	.65	.1445	.0000	1.9	.006
Ayer, ...	Large well, ...	00	7.18	.0004	.0026	.84	.0513	.0000	2.5	.007
	Tubular wells, ...	00	5.57	.0005	.0026	.26	.0060	.0000	2.2	.007
Barnstable, ...	Tubular wells, ...	00	3.75	.0008	.0028	1.15	.0027	.0000	0.7	.008

Averages of Chemical Analyses of Ground-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS —		Hardness.	Iron.
				Free.	Albu- minoid.		Nitrates.	Nitrites.		
Bedford, . . .	Large well, . . .	.03	3.66	.0006	.0034	.38	.0032	.0000	1.2	.026
Billerica, . . .	Tubular wells, . . .	.18	7.33	.0022	.0065	.52	.0044	.0000	2.7	.062
Braintree, . . .	Filter-gallery, . . .	.11	10.30	.0014	.0105	1.38	.1290	.0000	3.0	.012
Bridgewater, . . .	Wells, . . .	.03	6.05	.0012	.0031	.74	.0315	.0000	1.9	.045
Brookfield (East), . . .	Tubular wells, . . .	.00	2.91	.0004	.0018	.24	.0066	.0000	0.5	.009
Brookline, . . .	Tubular wells and filter-gallery, . . .	.19	9.02	.0044	.0083	.76	.0172	.0001	4.6	.050
Canton, . . .	Springdale well, . . .	.00	3.70	.0003	.0030	.44	.0077	.0000	1.3	.009
	Well near Henry's Spring, . . .	.03	4.80	.0006	.0051	.55	.0254	.0000	1.5	.007
Chelmsford (North), . . .	Tubular wells, . . .	.10	4.79	.0089	.0080	.51	.0363	.0000	1.8	.032
Chelmsford (Center), . . .	Tubular wells, . . .	.00	7.37	.0003	.0016	.61	.0855	.0000	2.6	.005
Chicopee (Fairview), . . .	Tubular wells, . . .	.00	4.37	.0003	.0018	.19	.0260	.0000	1.0	.016
Cohasset, . . .	Tubular wells No. 2, . . .	.07	14.84	.0008	.0073	1.98	.1120	.0000	5.7	.019
	Filtered water, . . .	.53	9.78	.0014	.0153	1.54	.0038	.0001	3.0	.031
Dedham, . . .	Large well and tubular wells, . . .	.04	10.76	.0017	.0060	1.16	.1020	.0000	4.3	.008
Deerfield (Fire District), . . .	Wells, . . .	.00	4.77	.0005	.0029	.16	.0011	.0000	2.6	.010
Douglas, . . .	Tubular wells, . . .	.00	4.74	.0005	.0025	.40	.0367	.0000	1.5	.049
Dracut (Water Supply District), . . .	Tubular wells, . . .	.00	9.00	.0005	.0020	.56	.0481	.0000	4.3	.011
Dracut (Collinsville), . . .	Tubular wells, . . .	.10	6.72	.0006	.0086	.45	.0352	.0000	2.6	.016
Dudley, . . .	Tubular wells, . . .	.00	3.54	.0005	.0023	.27	.0047	.0000	1.2	.006
Duxbury, . . .	Tubular wells, . . .	.00	3.96	.0005	.0019	.83	.0183	.0000	0.5	.006
Easthampton, . . .	Tubular wells, . . .	.00	7.15	.0001	.0017	.16	.0250	.0000	3.8	.009
Easton, . . .	Well, . . .	.00	5.02	.0007	.0024	.67	.0355	.0000	1.7	.007
Edgartown, . . .	Large well, . . .	.00	3.04	.0002	.0017	.94	.0013	.0000	0.4	.006
Fairhaven, . . .	Tubular wells, . . .	.53	8.32	.0014	.0149	1.07	.0522	.0000	2.6	.011
Foxborough, . . .	Tubular wells, . . .	.00	4.33	.0008	.0035	.50	.0380	.0000	1.3	.019
Framingham, . . .	Filter-gallery, . . .	.04	8.70	.0068	.0087	1.06	.0150	.0001	3.8	.014
Franklin, . . .	Tubular wells, . . .	.00	4.96	.0004	.0021	.56	.0263	.0000	1.6	.009
Grafton, . . .	Filter-gallery, . . .	.05	10.45	.0017	.0044	1.23	.1237	.0000	4.5	.007
Granville, . . .	Well, . . .	.01	4.25	.0003	.0030	.15	.0050	.0000	1.5	.011
Groton, . . .	Large well, . . .	.01	5.96	.0002	.0040	.26	.0015	.0000	3.1	.011
Groton (West Groton Water Supply District), . . .	Tubular wells, . . .	.00	4.72	.0002	.0015	.21	.0180	.0000	2.5	.007
Hingham, . . .	Wells, . . .	.14	5.85	.0061	.0076	.77	.0168	.0000	1.8	.009
Holliston, . . .	Large well, . . .	.56	5.39	.0046	.0206	.45	.0035	.0000	1.3	.170

Averages of Chemical Analyses of Ground-water Sources, etc. — Continued.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS —		Hardness.	Iron.
				Free.	Albuminoid.		Nitrates.	Nitrites.		
Hopkinton, . . .	Tubular wells, . . .	.00	15.05	.0004	.0026	1.40	.2967	.0000	6.0	.017
Kingston, . . .	Tubular wells, . . .	.00	4.74	.0001	.0014	.73	.0078	.0000	1.1	.011
Leicester (Cherry Valley and Rochdale Water Supply District), . . .	Wells, . . .	.05	5.28	.0048	.0058	.32	.0042	.0000	2.2	.010
Littleton, . . .	Tubular wells, . . .	.00	3.78	.0001	.0021	.23	.0184	.0000	1.7	.006
Lowell, . . .	Boulevard wells (tubular), . . .	.33	6.43	.0293	.0081	.42	.0191	.0000	2.8	.146
Manchester, . . .	Wells, . . .	.00	12.33	.0003	.0021	1.99	.1223	.0000	4.3	.014
Mansfield, . . .	Large well, . . .	.00	3.90	.0003	.0012	.47	.0513	.0000	1.2	.006
Marblehead, . . .	Wells and brook, filtered, . . .	.15	22.08	.0010	.0086	4.51	.0136	.0000	8.3	.016
Marion, . . .	Tubular wells, . . .	.00	4.29	.0004	.0023	.75	.0258	.0000	1.1	.006
Marshfield, . . .	Well, . . .	.00	17.45	.0003	.0021	5.50	.1200	.0000	3.7	.014
Mattapoisett, . . .	Tubular wells, . . .	.00	6.25	.0004	.0022	.99	.0517	.0000	2.2	.006
Medfield, . . .	Spring, . . .	.01	3.83	.0006	.0045	.39	.0073	.0000	1.3	.007
Medway, . . .	Tubular wells, . . .	.00	7.00	.0003	.0021	.57	.0413	.0000	2.9	.007
Merrimac, . . .	Tubular wells, . . .	.00	6.73	.0003	.0022	.55	.0100	.0000	2.8	.015
Methuen, . . .	Tubular wells, . . .	.30	7.97	.0024	.0109	.48	.0130	.0000	3.2	.082
Middleborough, . . .	Well, . . .	.31	7.14	.0048	.0097	.70	.0322	.0001	2.5	.321
	Filtered water, . . .	.05	6.41	.0007	.0054	.72	.0315	.0001	2.3	.034
Millbury, . . .	Well, . . .	.00	4.68	.0005	.0047	.36	.0072	.0000	1.7	.010
Millis, . . .	Spring, . . .	.00	9.80	.0003	.0011	.82	.1750	.0000	3.6	.008
Monson, . . .	Large well, . . .	.03	3.80	.0002	.0033	.20	.0088	.0000	1.2	.007
Natick, . . .	Large well, . . .	.00	9.15	.0004	.0030	.78	.0257	.0000	4.6	.005
Needham, . . .	Well No. 1, . . .	.01	7.25	.0003	.0033	.75	.0973	.0000	2.5	.006
	Well No. 2, . . .	.00	7.03	.0006	.0035	.78	.0800	.0000	2.6	.007
	Hicks Spring, . . .	.02	6.68	.0006	.0034	.75	.1010	.0000	2.0	.006
Newburyport, . . .	Wells and springs, . . .	.06	7.52	.0019	.0064	.76	.0258	.0001	3.0	.025
Newton, . . .	Tubular wells and filter-gallery, . . .	.06	6.67	.0010	.0047	.55	.0263	.0000	2.8	.014
No. Attleborough; . . .	Wells, . . .	.00	5.62	.0005	.0019	.51	.0175	.0000	2.2	.009
Norton, . . .	Tubular wells, . . .	.00	4.48	.0001	.0017	.41	.0022	.0000	1.3	.006
Norwood, . . .	Tubular wells, . . .	.03	10.91	.0007	.0042	.63	.0409	.0001	4.9	.025
Oak Bluffs, . . .	Springs, . . .	.00	4.20	.0007	.0023	.95	.0167	.0000	0.8	.010
Oxford, . . .	Tubular wells, . . .	.00	4.68	.0002	.0014	.34	.0277	.0000	1.7	.007
Palmer (Bondsville), . . .	Tubular wells, . . .	.00	5.52	.0003	.0025	.19	.0165	.0000	1.8	.034
Peabody, . . .	Tubular wells, . . .	1.39	8.85	.0346	.0243	.78	.0035	.0000	3.1	.810

Averages of Chemical Analyses of Ground-water Sources, etc. — Concluded.

[Parts in 100,000.]

CITY OR TOWN.	Source.	Color.	Residue on Evaporation.	AMMONIA.		Chlorine.	NITROGEN AS —		Hardness.	Iron.
				Free.	Albu- minoid.		Nitrates.	Nitrites.		
Pepperell, . . .	Tubular wells, . . .	.00	3.42	.0002	.0022	.22	.0032	.0000	1.3	.007
Plainville, . . .	Tubular wells, . . .	.00	5.05	.0002	.0018	.36	.0018	.0000	2.1	.014
Provincetown, . . .	Tubular wells in Truro, . . .	.00	12.70	.0003	.0021	4.91	.0034	.0000	2.7	.014
Reading, . . .	Filter-gallery, . . .	.65	19.47	.0367	.0185	4.23	.0116	.0001	5.0	.473
	Filtered water, . . .	.25	26.12	.0014	.0128	3.82	.0164	.0008	11.8	.019
Scituate, . . .	Tubular wells, . . .	.00	16.97	.0000	.0028	3.45	.1775	.0001	5.5	.008
Sharon, . . .	Well, . . .	.00	11.86	.0004	.0014	1.53	.2200	.0000	4.9	.004
	Tubular wells, . . .	.00	4.54	.0000	.0011	.49	.0334	.0000	1.6	.007
Sheffield, . . .	Spring, . . .	.00	3.37	.0015	.0019	.11	.0037	.0000	1.8	.006
Shirley, . . .	Well, . . .	.00	4.42	.0002	.0018	.46	.0778	.0000	1.4	.005
South Hadley (Fire District No. 2).	Large well, . . .	.00	3.80	.0004	.0014	.18	.0377	.0000	1.3	.008
Tisbury, . . .	Well, . . .	.00	4.25	.0001	.0020	.91	.0070	.0000	0.7	.008
Uxbridge, . . .	Tubular wells, . . .	.00	5.12	.0005	.0026	.59	.0592	.0000	1.8	.006
Walpole, . . .	Tubular wells, . . .	.00	4.80	.0003	.0024	.47	.0312	.0000	1.9	.015
Waltham, . . .	Old well, . . .	.10	8.54	.0038	.0045	.81	.0149	.0000	3.7	.052
	New well, . . .	.00	7.72	.0021	.0045	.70	.0192	.0000	3.4	.010
Ware, . . .	Wells, . . .	.00	6.18	.0002	.0024	.41	.0863	.0000	2.2	.005
Wareham (Fire District).	Tubular wells, . . .	.00	3.26	.0005	.0017	.60	.0035	.0000	0.8	.007
Warren (West), . . .	Large well, . . .	.00	5.32	.0007	.0026	.17	.0068	.0000	1.9	.009
Webster, . . .	Wells, . . .	.02	3.96	.0014	.0045	.34	.0108	.0000	1.4	.011
Wellesley, . . .	Tubular wells, . . .	.00	10.03	.0005	.0028	1.13	.0623	.0000	4.4	.010
	Well at Williams Spring, . . .	.00	16.05	.0033	.0032	1.51	.6533	.0000	5.8	.012
Westborough, . . .	Filter basin, . . .	.03	3.08	.0017	.0109	.30	.0012	.0000	1.0	.015
West Brookfield, . . .	Tubular wells, . . .	.00	4.21	.0003	.0016	.24	.0200	.0000	1.1	.008
Westford, . . .	Tubular wells, . . .	.00	4.02	.0003	.0013	.18	.0120	.0000	1.6	.011
Weston, . . .	Well, . . .	.16	7.55	.0012	.0092	.64	.0272	.0000	3.2	.008
Winchendon, . . .	Wells, . . .	.11	3.36	.0036	.0050	.17	.0076	.0000	1.0	.153
Woburn, . . .	Wells, . . .	.00	11.25	.0014	.0042	1.50	.0257	.0000	5.4	.005
Worthington, . . .	Springs, . . .	.00	2.52	.0006	.0026	.14	.0032	.0000	1.0	.016
Wrentham, . . .	Tubular wells, . . .	.00	3.95	.0004	.0016	.40	.0352	.0000	1.2	.006

EXAMINATION OF RIVERS.

All of the important rivers of the State were examined during the year and the condition of each is described on pages 55 to 62.

The flow of streams during the year was quite abnormal. In the months of January, February and December the flow was somewhat greater than the average. In the months of March, April, May and June the flow was the lowest that has been recorded on the Nashua River since observations of the flow of that stream were begun in 1897. The great rainfall of July produced the highest flow for that month with the exception of July, 1897, and the flow for August was the highest on record, being four times the average flow for that month. In September, October and November the flow on the Nashua River was slightly less than the normal.

The records of flow of the Sudbury River for the year 1915, compared with other years in the long period covered by the observations on that stream, show that the flow for the month of July, 1915, was the highest ever recorded since observations on that stream were begun in 1875, and the flow for the month of August was the highest for that month within that period except in the year 1889.

The influence of this excessive flow of streams during the warmest months of the year was to reduce very greatly the effect of the pollution of streams in the period of the year when objectionable conditions are likely to be most noticeable. On the other hand, there was a marked increase in manufacturing as compared with previous years, and notwithstanding the great dilution caused by the high flow of streams in the summer season the pollution of the rivers, as shown by chemical analyses, was more noticeable than in previous years.

The results of chemical examinations of the following rivers are presented herewith: —

Assabet.
Blackstone.
Charles.
Chicopee.
Concord.
Connecticut.

Deerfield.
French.
Green.
Hoosick.
Housatonic.
Merrimack.

Mill (Northampton).
 Miller's.
 Nashua.
 Nemasket.
 Neponset.
 Quaboag.
 Quinebaug.

Salisbury Plain.
 Shawsheen.
 Sudbury.
 Taunton.
 Ten Mile.
 Ware.
 Westfield.

BLACKSTONE RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 56.

BLACKSTONE RIVER.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Blackstone River, below Cherry Valley.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.		Nitrates.		Nitrites.			
					Total.	Dissolved.				Suspended.		
1908, ...	-	20.57	3.83	.1531	.0624	.0508	.0116	5.76	.0020	.0007	-	-
1909, ...	.35	13.93	3.34	.0681	.0470	.0334	.0136	3.70	.0125	.0003	.80	-
1910, ...	.32	16.42	3.92	.0633	.0489	.0387	.0102	4.02	.0146	.0002	.85	-
1911, ...	-	21.02	4.40	.1277	.0726	.0559	.0167	5.70	.0080	.0005	1.15	-
1912, ¹	-	44.10	11.04	.2514	.2884	.1023	.1861	10.70	.0002	.0004	3.08	-
1913, ...	-	32.32	6.52	.2591	.1628	.1122	.0506	8.18	.0015	.0004	2.06	-
1914, ...	-	44.73	7.27	.3430	.1857	.1379	.0478	12.83	.0000	.0001	2.12	-
1915, ...	-	19.23	5.15	.0985	.1142	.0785	.0357	3.08	-	-	1.89	-

¹ August omitted.

BLACKSTONE RIVER.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER, ETC. —

*Continued.**Blackstone River, between Mill Brook Channel and the Sewage Precipitation Works of the City of Worcester.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.	
					Total.	Dissolved.	Suspended.				
1887, ...	0.91	-	-	.2686	.1741	-	-	1.35	.0160	-	-
1888, ...	0.76	-	-	.2658	.1112	.0557	.0555	1.50	.0382	.0041	-
1889, ...	0.86	-	-	.3980	.1430	.0772	.0658	1.32	.0177	.0026	-
1890, ...	1.14	9.92	3.03	.2107	.1246	.0673	.0573	1.07	.0250	.0015	2.9
1891, ...	1.10	17.42	5.59	.4913	.1950	.1127	.0823	2.29	.0192	.0037	5.0
1892, ...	0.52	20.75	6.30	.3547	.1433	.0708	.0725	2.43	.0227	.0108	6.1
1893, ...	0.40	16.98	4.55	.1480	.0588	.0240	.0348	1.01	.0115	.0015	6.3
1894, ...	0.66	16.93	4.76	.0548	.0380	.0236	.0144	0.74	.0115	.0005	4.4
1895, ...	0.49	14.17	4.50	.0613	.0414	.0243	.0171	0.92	.0163	.0006	3.4
1896, ...	0.51	12.90	2.93	.0780	.0415	.0282	.0133	0.97	.0147	.0015	3.4
1897, ...	0.85	26.45	7.68	.1130	.0674	.0362	.0312	0.89	.0090	.0024	4.2
1898, ...	0.33	17.42	5.62	.0857	.0619	.0260	.0359	0.96	.0053	.0010	4.6
1899, ...	0.14	34.38	10.60	.2583	.0788	.0390	.0398	-	-	.0004	14.3
1900, ...	0.05	16.48	3.38	.1068	.0518	.0210	.0308	1.03	.0107	.0012	3.6
1901, ...	0.23	31.03	11.68	.1410	.0548	.0309	.0239	-	-	.0023	13.8
1902, ...	0.10	46.15	12.47	.2453	.0728	.0274	.0454	-	-	.0010	16.5
1903, ...	0.18	24.06	6.80	.2836	.0750	.0472	.0278	-	-	.0027	8.4
1904, ...	0.12	44.68	17.08	.1228	.0434	.0225	.0209	-	-	.0008	14.7
1905, ...	0.21	50.36	19.49	.0952	.0492	.0203	.0289	-	-	.0003	29.3
1906, ...	0.11	40.07	15.25	.0688	.0421	.0189	.0232	-	.0032	.0002	20.3
1907, ...	0.04	44.07	17.67	.0613	.0343	.0180	.0163	-	-	.0003	-
1908, ...	0.16	23.67	5.55	.0990	.0291	.0153	.0138	3.23	.0134	.0014	-
1909, ...	-	52.97	18.55	.1865	.0381	.0239	.0142	4.80	.0033	.0010	-
1910, ...	0.15	50.92	18.97	.1933	.0545	.0309	.0236	4.07	.0023	.0009	-
1911, ...	0.11	44.64	15.70	.1920	.0449	.0212	.0237	4.03	.0170	.0009	-
1912, ...	0.10	40.05	10.91	.2047	.0352	.0225	.0127	3.58	.0027	.0011	-
1913, ...	0.10	35.17	10.34	.2767	.0491	.0285	.0206	3.18	.0003	.0008	-
1914, ...	0.14	35.03	8.23	.2993	.0771	.0510	.0261	3.85	.0012	.0018	-
1915, ...	0.13	39.00	11.68	.2383	.0650	.0392	.0258	2.96	-	-	-

BLACKSTONE RIVER.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER, ETC. —
*Continued.**Blackstone River, below Sewage Precipitation Works.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Hardness.
		Total.	Loss on Ignition.	ALBUMINOID.					Nitrates.	Nitrites.	
				Free.	Total.	Dissolved.	Suspended.				
1890,	0.97	11.36	3.10	.2907	.1492	.0722	.0770	1.46	.0270	.0018	3.9
1891,	1.05	22.25	6.60	.6367	.1508	.0883	.0625	2.61	.0233	.0040	6.2
1892,	0.63	26.80	7.75	.5240	.1810	.0958	.0852	3.13	.0137	.0050	10.3
1893,	0.51	30.00	7.13	.5680	.1453	.0900	.0553	2.76	.0285	.0126	10.9
1894,	0.40	29.30	5.86	.6189	.1390	.1113	.0277	2.63	.0212	.0071	10.6
1895,	0.71	22.15	5.18	.3246	.0898	.0597	.0301	1.86	.0267	.0063	7.3
1896,	0.30	26.03	6.53	.2831	.0898	.0600	.0298	2.10	.0217	.0118	9.7
1897,	0.73	25.98	4.97	.3650	.1122	.0782	.0340	1.61	.0207	.0063	6.9
1898,	0.23	25.63	6.73	.3064	.0868	.0560	.0308	1.55	.0132	.0119	9.2
1899,	0.14	44.02	9.67	.5251	.1707	.0912	.0795	3.26	.0108	.0068	16.1
1900,	0.22	24.57	4.48	.4430	.1249	.0621	.0628	2.13	.0110	.0145	7.3
1901,	0.09	31.12	6.90	.4580	.1293	.0772	.0521	3.42	.0090	.0058	10.8
1902,	0.15	49.62	13.38	.7296	.1284	.0736	.0548	2.97	—	.0033	12.5
1903,	0.39	31.08	9.48	.3880	.1080	.0545	.0535	—	—	.0062	10.4
1904,	—	50.25	13.73	.6381	.1523	.0601	.0922	—	—	.0027	16.9
1905,	0.19	59.84	17.97	.4936	.0985	.0597	.0388	—	—	.0008	29.3
1906,	0.19	49.69	11.42	.6330	.1818	.0580	.1238	—	.0055	.0130	15.0
1908,	0.30	38.80	7.63	.9407	.1490	.0781	.0709	5.34	.0040	.0033	—
1909,	—	53.79	12.12	1.0567	.1282	.0792	.0490	6.92	.0067	.0075	—
1910,	—	52.15	12.52	1.0090	.1654	.0817	.0837	5.68	.0015	.0034	—
1911,	0.21	53.25	13.15	.9967	.1608	.0651	.0957	6.54	.0152	.0072	—
1912,	0.23	48.90	10.08	1.1700	.1673	.0904	.0769	6.12	.0137	.0096	—
1913, ¹	0.28	40.68	10.46	.9320	.1286	.0719	.0567	4.49	.0158	.0084	—
1914,	0.25	43.46	9.08	.8577	.1114	.0770	.0344	4.87	.0038	.0091	—
1915,	0.13	39.45	6.77	.6370	.1032	.0575	.0457	3.58	—	—	—

¹ September omitted.

BLACKSTONE RIVER.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER, ETC. —
*Continued.**Blackstone River, at Uxbridge.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.	
					Total.	Dissolved.	Suspended.				
1887,	.39	—	—	.1129	.0271	—	—	0.79	.0360	—	—
1888,	.38	6.42	1.52	.1155	.0288	.0222	.0066	0.68	.0310	.0007	—
1889,	.32	—	—	.1133	.0296	.0192	.0104	0.66	.0333	.0009	—
1890,	.26	8.86	2.12	.1629	.0231	.0174	.0057	0.79	.0259	.0005	2.9
1891,	.20	10.16	2.61	.2280	.0175	.0117	.0058	1.04	.0425	.0007	3.6
1892,	.13	9.36	1.88	.2840	.0227	.0162	.0065	0.99	.0313	.0007	3.1
1893,	.24	11.74	2.37	.1985	.0207	.0140	.0067	1.20	.0623	.0050	4.2
1894,	.35	13.07	2.03	.1456	.0243	.0183	.0060	1.57	.0673	.0050	4.9
1895,	.56	12.95	2.69	.0906	.0258	.0182	.0076	1.34	.0631	.0065	4.7
1896,	.33	12.68	2.67	.1129	.0257	.0221	.0036	1.38	.0477	.0091	5.0
1897,	.48	11.60	2.47	.1029	.0280	.0215	.0065	1.32	.0652	.0051	4.3
1898,	.49	10.59	2.78	.0801	.0264	.0219	.0045	1.00	.0470	.0076	3.8
1899,	.18	18.34	3.11	.2490	.0359	.0310	.0049	2.17	.0510	.0141	7.4
1900,	.19	13.42	2.04	.2260	.0347	.0257	.0090	1.76	.0558	.0060	5.0
1901,	.22	13.91	2.67	.3159	.0285	.0240	.0045	1.50	.0195	.0035	5.0
1902,	.15	14.17	2.56	.3462	.0270	.0218	.0052	1.95	.0210	.0018	4.9
1903,	.30	13.16	2.52	.3030	.0262	.0215	.0047	1.74	.0210	.0024	4.4
1904,	.20	13.78	2.74	.2399	.0282	.0214	.0068	2.12	.0408	.0022	4.6
1905,	.21	16.34	2.55	.3928	.0246	.0203	.0043	2.65	.0175	.0025	5.0
1906,	.19	14.73	3.10	.2218	.0242	.0200	.0042	2.10	.0252	.0009	4.2
1907,	.37	14.23	2.58	.2331	.0238	.0182	.0056	2.36	.0330	.0040	4.5
1908,	.31	16.33	4.07	.2387	.0253	.0196	.0057	3.05	.0408	.0071	—
1909,	.22	18.31	4.35	.3473	.0273	.0216	.0057	3.64	.0325	.0066	—
1910,	.26	22.53	4.69	.4963	.0356	.0302	.0054	4.62	.0498	.0043	—
1911,	.26	23.10	3.85	.3717	.0293	.0225	.0068	4.15	.0558	.0173	—
1912,	.21	21.91	3.06	.4897	.0345	.0288	.0057	4.06	.0497	.0137	6.5
1913,	.29	19.48	3.70	.3880	.0355	.0281	.0074	3.34	.0382	.0107	5.5
1914,	.25	23.72	2.84	.5285	.0355	.0284	.0071	4.55	.0482	.0154	7.2
1915,	.30	19.63	2.75	.3068	.0381	.0302	.0079	3.10	—	—	6.3

BLACKSTONE RIVER.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER, ETC. —
*Concluded.**Blackstone River, at Millville.*

[Parts in 100,000.]

YEAR.		Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Hardness.
					ALBUMINOID.			Nitrates.		Nitrites.		
			Total.	Loss on Ignition.	Free.	Total.	Dissolved.				Suspended.	
1887,	.	.31	—	—	.0468	.0220	—	—	0.51	.0210	—	—
1888,	.	.41	5.22	1.40	.0467	.0296	.0233	.0063	0.50	.0278	.0004	—
1889,	.	.38	—	—	.0499	.0273	.0213	.0060	0.45	.0167	.0003	—
1890,	.	.26	6.71	2.24	.0736	.0196	.0152	.0044	0.53	.0229	.0003	2.3
1891,	.	.24	7.48	2.35	.1105	.0384	.0234	.0150	0.72	.0308	.0006	2.2
1892,	.	.37	6.70	1.62	.1143	.0294	.0210	.0084	0.63	.0217	.0002	2.0
1893,	.	.23	7.43	1.73	.0677	.0119	.0087	.0032	0.77	.0385	.0011	2.6
1894,	.	.47	8.42	2.16	.0510	.0172	.0139	.0033	0.89	.0273	.0012	2.8
1895,	.	.51	8.67	2.55	.0356	.0233	.0180	.0053	0.90	.0383	.0024	3.2
1896,	.	.35	8.53	1.69	.0484	.0237	.0180	.0057	0.97	.0413	.0027	3.3
1897,	.	.45	7.66	1.98	.0509	.0258	.0210	.0048	0.92	.0445	.0019	3.1
1898,	.	.51	7.12	2.17	.0325	.0240	.0193	.0047	0.63	.0240	.0023	2.5
1899,	.	.20	12.50	2.44	.1310	.0301	.0247	.0054	1.31	.0310	.0049	4.6
1900,	.	.29	9.33	1.82	.1168	.0254	.0219	.0035	1.15	.0417	.0039	3.4
1901,	.	.31	8.62	2.13	.1420	.0288	.0227	.0061	0.87	.0155	.0006	3.1
1902,	.	.28	9.43	2.24	.1623	.0284	.0238	.0046	1.20	.0195	.0010	2.8
1903,	.	.33	8.46	1.85	.1397	.0233	.0189	.0044	1.10	.0192	.0010	2.9
1904,	.	.29	8.71	2.06	.1079	.0235	.0201	.0034	1.26	.0337	.0009	2.9
1905,	.	.28	10.76	2.03	.1956	.0311	.0222	.0089	1.67	.0207	.0008	2.9
1906,	.	.37	9.02	2.15	.1526	.0306	.0251	.0055	1.27	.0188	.0006	2.4
1907,	.	.37	10.43	2.21	.1521	.0240	.0181	.0059	1.61	.0247	.0014	3.1
1908,	.	.33	9.85	2.53	.1295	.0232	.0185	.0047	1.78	.0258	.0024	3.4
1909,	.	.24	11.87	3.17	.1595	.0267	.0220	.0047	2.27	.0225	.0019	—
1910,	.	.30	13.94	3.32	.2350	.0277	.0234	.0043	3.01	.0290	.0013	—
1911,	.	.33	14.35	2.79	.1787	.0268	.0222	.0046	2.94	.0355	.0051	—
1912,	.	.29	15.20	2.18	.2433	.0283	.0249	.0034	2.91	.0421	.0064	—
1913,	.	.37	12.92	2.38	.1631	.0281	.0237	.0044	2.44	.0345	.0063	—
1914,	.	.28	14.33	2.78	.2245	.0304	.0243	.0061	2.78	.0233	.0065	—
1915,	.	.42	13.55	2.02	.1379	.0361	.0267	.0094	2.12	—	—	—

CHARLES RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 56.

CHARLES RIVER.

CHEMICAL EXAMINATION OF WATER FROM CHARLES RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Charles River, above Milford.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1899.	.28	3.98	1.70	.0017	.0248	.0223	.0025	.27	.0027	.0003	.48	0.6
1900.	.49	3.93	1.67	.0017	.0251	.0231	.0020	.25	.0030	.0000	.64	0.5
1901.	.46	4.30	2.48	.0066	.0286	.0247	.0039	.25	.0060	.0002	.65	0.6
1902.	.58	4.42	1.90	.0025	.0248	.0210	.0038	.29	.0057	.0001	.70	1.1
1903. ¹	.55	4.17	1.86	.0015	.0203	.0171	.0032	.28	.0080	.0001	.68	0.8
1904. ²	.49	3.95	1.83	.0117	.0267	.0209	.0058	.33	.0035	.0001	.62	1.1
1905. ³	.55	3.77	1.62	.0020	.0229	.0201	.0028	.31	.0033	.0001	.56	0.8
1906. ³	.62	4.05	1.90	.0032	.0257	.0230	.0027	.30	.0073	.0001	.68	0.6
1907.	.43	3.79	1.59	.0020	.0198	.0173	.0025	.32	.0047	.0001	.48	0.8
1908.	.36	3.11	1.43	.0023	.0198	.0171	.0027	.33	.0025	.0001	.42	0.5
1909.	.31	3.52	1.62	.0030	.0207	.0176	.0031	.32	.0012	.0000	.39	0.7
1910.	.37	3.47	1.34	.0042	.0231	.0204	.0027	.37	.0011	.0001	.46	0.8
1911.	.40	3.94	1.48	.0036	.0210	.0183	.0027	.42	.0007	.0000	.56	1.1
1912.	.38	3.62	1.29	.0037	.0226	.0182	.0044	.37	.0018	.0001	.45	1.0
1913. ³	.47	4.40	1.50	.0060	.0245	.0222	.0023	.39	.0023	.0002	.49	0.9
1914. ³	.34	4.03	1.43	.0046	.0228	.0178	.0050	.41	.0000	.0000	.35	0.9
1915. ³	.75	5.00	2.27	.0039	.0296	.0260	.0036	.41	-	-	.84	1.1

¹ October omitted.² Two months.³ Three months.*Charles River, below Milford.*

1898,	.63	10.47	3.08	.1195	.0597	.0422	.0175	2.47	.0473	.0064	.69	2.4
1899,	.50	12.52	3.12	.3487	.1345	.0803	.0542	3.00	.0053	.0008	1.12	2.6
1900,	.56	12.85	2.65	.7123	.0764	.0563	.0201	2.74	.0140	.0055	.93	3.1
1901,	.63	9.52	3.37	.1419	.0451	.0317	.0134	1.40	.0422	.0048	.86	2.6
1902,	.52	10.74	3.38	.2118	.0658	.0406	.0252	2.21	.0236	.0049	1.02	2.7
1903, ¹	.49	9.03	2.85	.2237	.0479	.0277	.0202	1.36	.0396	.0050	.66	2.5
1904, ²	.50	9.20	2.94	.2105	.0508	.0350	.0158	1.44	.0513	.0055	.63	2.6
1906, ³	.68	8.76	2.90	.1536	.0568	.0427	.0141	1.64	.0160	.0012	.92	2.0
1907,	.54	12.95	2.83	.4607	.0864	.0525	.0339	2.94	.0352	.0021	.86	3.2
1908,	.48	10.81	3.48	.3925	.0598	.0347	.0251	1.79	.0218	.0049	.64	-
1909,	.50	12.66	4.07	.5658	.0479	.0399	.0080	1.89	.0273	.0064	.72	-
1910,	.57	15.21	3.83	.8038	.0640	.0499	.0141	3.01	.0248	.0082	.88	4.2
1911,	.58	14.12	3.64	.2881	.0447	.0323	.0124	2.51	.0785	.0114	.75	4.4
1912,	.47	15.99	3.24	.5413	.0480	.0370	.0110	2.67	.0880	.0101	.64	5.5
1913,	.58	13.58	3.65	.2918	.0536	.0361	.0175	1.94	.0505	.0108	.96	3.8
1914,	.48	12.47	2.87	.2817	.0470	.0368	.0102	1.74	.0298	.0085	.74	3.3
1915,	.72	12.00	3.58	.1327	.0587	.0344	.0243	1.61	-	-	1.04	3.1

¹ November omitted.² Four months.³ June omitted.

CHARLES RIVER.

CHEMICAL EXAMINATION OF WATER FROM CHARLES RIVER, ETC. — *Concluded.**Charles River, opposite Pumping Station of Brookline Water Works.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1887.	.83	5.37	1.62	0013	0282	—	—	.44	0087	—	—	—
1888.	.98	4.87	1.92	0014	0264	0240	0024	.37	0062	0002	—	—
1895.	.74	4.91	2.08	0004	0237	0207	0030	.48	0055	0001	.75	1.5
1897.	1.02	5.36	2.45	0012	0288	0262	0026	.43	0067	0001	.86	1.5
1898.	.87	5.22	2.40	0012	0303	0281	0022	.39	0035	0001	.92	1.4
1899.	.46	5.03	1.92	0011	0262	0230	0032	.45	0025	0001	.62	1.5
1900.	.56	4.96	1.60	0018	0252	0229	0023	.46	0020	0000	.70	1.4
1901.	.92	5.45	2.60	0020	0314	0275	0039	.41	0047	0001	.95	1.4
1902.	.52	5.46	2.03	0031	0234	0211	0023	.57	0045	0001	.64	1.6
1903.	.71	6.22	2.30	0031	0240	0223	0017	.53	0065	0001	.80	1.5
1904.	.51	5.24	2.17	0021	0224	0208	0016	.55	0060	0001	.67	1.6
1905. ¹	.84	5.93	2.60	0029	0318	0277	0041	.54	0056	0002	.92	1.5
1906. ¹	1.05	6.00	2.77	0039	0294	0267	0027	.53	0032	0001	1.17	1.4
1907. ¹	.63	6.15	2.40	0022	0246	0228	0018	.64	0026	0001	.73	1.7
1908. ¹	.55	5.93	2.29	0035	0248	0222	0026	.65	0036	0002	.61	1.7
1909. ²	.65	5.75	2.00	0023	0254	0236	0018	.69	0015	0001	.75	1.5
1910.	.60	6.71	2.79	0028	0289	0260	0029	.83	0013	0001	.72	1.8
1911.	.85	7.42	3.02	0040	0302	0258	0044	.80	0032	0001	1.10	2.0
1912.	.56	6.30	2.07	0043	0298	0237	0061	.85	0012	0001	.69	2.1
1913.	.74	7.32	2.27	0053	0342	0300	0042	.85	0043	0002	.86	2.0
1914.	.55	7.10	1.87	0055	0314	0265	0049	.92	0032	0001	.66	2.1

¹ Five months.² Two months.*Charles River, opposite Pumping Station of Waltham Water Works.*

1887.	.67	6.02	1.62	0029	0274	-	-	.48	0043	-	-	-
1888.	.82	5.47	1.88	0035	0310	0265	0045	.41	0087	0002	-	-
1897.	.95	6.06	2.45	0056	0322	0299	0023	.53	0073	0002	.83	1.9
1898.	.81	5.74	2.46	0050	0329	0296	0033	.44	0043	0001	.85	1.6
1899.	.41	5.50	1.81	0047	0264	0248	0016	.51	0051	0002	.52	1.9
1900.	.52	5.93	1.68	0064	0282	0259	0023	.53	0070	0002	.58	1.7
1901.	.82	5.93	2.72	0065	0322	0289	0033	.44	0067	0002	.85	1.8
1902.	.45	6.21	1.97	0084	0258	0228	0030	.62	0077	0003	.59	2.0
1903.	.64	6.06	2.21	0078	0267	0239	0028	.58	0084	0003	.71	2.0
1904.	.55	6.08	2.22	0062	0317	0266	0051	.62	0095	0002	.62	2.0
1905.	.79	6.29	2.54	0077	0363	0308	0055	.58	0075	0002	.80	1.7
1906.	1.00	6.70	2.58	0063	0335	0297	0038	.59	0038	0002	.98	1.8
1907. ¹	.58	6.22	2.24	0067	0278	0247	0031	.63	0058	0002	.65	2.0
1908.	.62	6.50	2.49	0048	0344	0284	0060	.69	0027	0001	.64	1.9
1909.	.54	6.79	2.36	0063	0349	0298	0051	.76	0026	0002	.53	2.0
1910.	.59	7.37	2.87	0078	0336	0299	0037	.81	0037	0003	.56	2.4
1911.	.75	7.47	2.95	0086	0343	0308	0035	.85	0030	0003	.87	2.3
1912.	.57	7.59	2.32	0095	0320	0280	0040	.92	0038	0002	.63	2.6
1913. ²	.68	7.68	2.54	0083	0437	0378	0059	.91	0041	0003	.74	2.3
1914.	.52	7.45	1.98	0117	0353	0297	0056	.92	0030	0002	.57	2.6
1915.	.93	8.30	2.97	0131	0475	0407	0068	.91	-	-	1.11	2.3

¹ July omitted.² June omitted.

CHICOPEE RIVER.

A general statement of the condition of this river and its tributaries during the year 1915 will be found on page 57.

CHICOPEE RIVER.

CHEMICAL EXAMINATION OF WATER FROM CHICOPEE RIVER AND ITS TRIBUTARIES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Ware River, below Ware.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1898,	.64	4.42	1.94	.0028	.0332	.0250	.0082	.19	.0025	.0003	.77	1.0
1899,	.46	4.82	1.77	.0052	.0371	.0268	.0103	.25	.0015	.0004	.66	0.9
1900,	.51	4.93	1.64	.0066	.0321	.0243	.0078	.25	.0030	.0003	.73	1.1
1901,	.73	4.79	2.15	.0082	.0300	.0242	.0058	.18	.0044	.0002	.84	1.3
1902,	.76	4.86	2.17	.0071	.0348	.0252	.0096	.23	.0040	.0003	.93	1.0
1903, ¹	.68	4.83	2.18	.0072	.0345	.0240	.0105	.25	.0034	.0003	.78	0.8
1904, ¹	.60	5.60	2.36	.0043	.0411	.0285	.0126	.29	.0046	.0004	.72	1.1
1908,	.56	7.38	2.86	.0265	.0418	.0264	.0154	.37	.0033	.0005	.80	—
1909, ¹	.61	8.63	3.05	.0354	.0569	.0357	.0212	.44	.0015	.0006	.98	—
1910,	.57	9.82	4.39	.0655	.0622	.0426	.0196	.60	.0040	.0011	.84	—
1911,	.70	9.15	3.37	.0396	.0554	.0375	.0179	.48	.0015	.0003	.98	—
1912,	.62	10.93	3.23	.0592	.0717	.0491	.0226	.61	.0015	.0014	.95	—
1913,	.66	9.74	2.97	.0525	.0634	.0432	.0202	.51	.0023	.0005	.96	—
1914,	.60	10.47	3.15	.0501	.0704	.0488	.0216	.53	.0012	.0006	.82	—
1915,	.76	9.43	3.41	.0317	.0746	.0427	.0319	.42	—	—	1.16	—

¹ September omitted.*Quabog River, below Palmer.*

1899,	.35	4.54	1.68	.0048	.0252	.0208	.0044	.26	.0060	.0002	.44	1.1
1900,	.40	4.56	1.58	.0038	.0218	.0176	.0042	.26	.0062	.0001	.48	1.2
1901,	.42	4.32	1.74	.0043	.0255	.0202	.0053	.23	.0052	.0002	.53	1.1
1902,	.41	4.55	1.64	.0077	.0242	.0196	.0046	.33	.0085	.0002	.53	1.2
1903,	.44	4.36	1.67	.0090	.0242	.0186	.0056	.27	.0092	.0033	.51	1.0
1904,	.40	4.68	1.70	.0191	.0253	.0195	.0058	.31	.0082	.0002	.50	1.1
1908,	.36	5.31	1.98	.0061	.0207	.0149	.0058	.40	.0070	.0003	.42	-
1909,	.31	5.43	1.95	.0068	.0211	.0165	.0046	.41	.0058	.0003	.47	-
1910,	.44	6.05	2.28	.0043	.0238	.0168	.0070	.52	.0057	.0003	.73	-
1911, ¹	.39	5.94	2.08	.0060	.0191	.0145	.0046	.44	.0032	.0002	.53	-
1912,	.40	7.63	2.08	.0087	.0209	.0144	.0065	.46	.0068	.0001	.58	-
1913, ²	.58	7.67	1.81	.0108	.0278	.0164	.0114	.46	.0042	.0001	.61	-
1914,	.49	6.62	1.62	.0144	.0243	.0176	.0067	.49	.0045	.0004	.35	-
1915,	.56	6.00	2.12	.0128	.0336	.0236	.0100	.40	-	-	.62	-

¹ Four months.² June omitted.

CHICOPEE RIVER.

CHEMICAL EXAMINATION OF WATER FROM CHICOPEE RIVER AND ITS TRIBUTARIES, ETC. — *Concluded.**Swift River, below Bondsville.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				Free.	ALBUMINOID.				Nitrates.	Nitrites.		
		Total.	Loss on Ignition.		Total.	Dissolved.	Suspended.					
1908, ¹	.34	5.45	2.42	.0047	.0217	.0132	.0085	.21	.0013	.0002	.44	-
1909, ²	.40	4.60	1.70	.0016	.0196	.0139	.0057	.22	.0000	.0001	.60	-
1910,	.33	5.28	2.05	.0031	.0261	.0196	.0065	.25	.0010	.0001	.60	-
1911,	.48	5.05	2.12	.0021	.0278	.0193	.0085	.21	.0007	.0000	.74	-
1912,	.28	5.02	1.92	.0047	.0268	.0184	.0084	.21	.0008	.0001	.54	-
1913,	.36	5.32	1.95	.0024	.0296	.0204	.0092	.26	.0008	.0001	.58	-
1914,	.35	4.97	1.67	.0037	.0304	.0219	.0085	.20	.0025	.0002	.55	-
1915,	.46	4.95	1.83	.0052	.0269	.0202	.0067	.24	-	-	.64	-

¹ Three months.² Two months.*Chicopee River, above Chicopee.*

1908, ¹	.42	5.21	1.98	.0100	.0240	.0177	.0063	.33	.0056	.0003	.62	-
1909, ²	.38	5.82	2.08	.0094	.0220	.0162	.0058	.36	.0046	.0004	.46	-
1910,	.45	6.14	2.06	.0099	.0239	.0191	.0048	.44	.0052	.0003	.50	-
1911,	.48	6.12	2.10	.0081	.0275	.0184	.0091	.42	.0067	.0004	.57	-
1912,	.41	6.83	2.03	.0159	.0287	.0221	.0066	.50	.0108	.0005	.47	-
1913,	.43	6.68	2.13	.0146	.0302	.0211	.0091	.44	.0067	.0006	.50	-
1914,	.33	6.50	2.00	.0163	.0278	.0212	.0066	.51	.0095	.0008	.40	-
1915,	.61	6.45	1.98	.0168	.0295	.0242	.0053	.39	-	-	.64	-

¹ October omitted.² September omitted.

CONCORD RIVER.

A general statement of the condition of this river and its tributaries during the year 1915 will be found on pages 55 and 57.

CONCORD RIVER.

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Sudbury River, below Saxonville.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1901, . . .	.84	7.22	3.37	.0073	.0624	.0431	.0193	.38	.0050	.0005	1.05	1.9
1902, . . .	.38	6.39	2.57	.0150	.0424	.0272	.0152	.60	.0103	.0005	.55	2.2
1903, . . .	.52	7.77	2.78	.0028	.0549	.0296	.0253	.65	.0080	.0002	.83	2.1
1904, . . .	.48	9.58	3.57	.0569	.0587	.0385	.0202	.87	.0193	.0032	.88	2.5
1906, ¹ . . .	.67	6.88	2.90	.0258	.0525	.0381	.0144	.56	.0058	.0004	.92	1.9
1907, ² . . .	.65	9.07	3.28	.1357	.0653	.0347	.0306	.84	.0063	.0004	.84	2.1
1908, ³ . . .	.44	9.67	3.72	.0039	.0634	.0374	.0260	1.06	.0128	.0009	.69	—
1909, . . .	.43	6.81	2.59	.0174	.0330	.0256	.0074	.64	.0043	.0005	.64	—
1910, . . .	.49	9.78	3.45	.0454	.0606	.0345	.0261	.83	.0040	.0010	.65	—
1911, . . .	.37	9.03	3.08	.0287	.0410	.0281	.0129	.92	.0120	.0009	.54	—
1912, . . .	.49	8.83	2.75	.0238	.0366	.0253	.0113	1.19	.0137	.0031	.72	—
1913, . . .	.69	7.28	2.56	.0152	.0347	.0291	.0056	.90	.0185	.0023	.77	—
1914, . . .	.51	9.62	3.03	.0292	.0439	.0276	.0163	1.13	.0220	.0042	.61	—
1915, . . .	.97	6.67	2.75	.0129	.0408	.0319	.0089	.73	—	—	1.04	—

¹ June omitted.² Three months.³ August omitted.*Assabet River, above Westborough.*

1909, . . .	.56	6.01	2.20	.0048	.0217	.0194	.0023	.36	.0015	.0001	.69	-
1910, . . .	.90	7.37	3.12	.0029	.0251	.0229	.0022	.38	.0035	.0001	.86	-
1911, . . .	.97	8.02	3.39	.0061	.0441	.0354	.0087	.45	.0023	.0002	1.20	-
1912, . . .	.72	7.00	2.36	.0073	.0255	.0228	.0027	.44	.0061	.0002	.87	-
1913, . . .	1.25	8.26	3.73	.0095	.0469	.0392	.0077	.46	.0007	.0002	1.55	-
1914, . . .	.92	7.37	2.78	.0088	.0356	.0304	.0052	.41	.0034	.0001	.98	-
1915, . . .	1.56	8.08	4.02	.0046	.0453	.0406	.0047	.46	-	-	1.74	-

CONCORD RIVER.

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES, ETC. — *Continued.**Assabet River, below Westborough.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1909, . . .	1.70	19.24	8.91	.4140	.2281	.1616	.0665	1.94	.0005	.0005	2.90	-
1910, . . .	2.23	17.07	7.00	.2898	.1334	.1018	.0316	2.16	.0078	.0018	2.20	-
1911, . . .	.83	12.09	4.01	.0556	.0460	.0373	.0087	1.87	.0967	.0121	1.24	-
1912, . . .	.66	12.71	4.01	.0975	.0419	.0357	.0062	2.20	.1998	.0132	.95	-
1913, . . .	1.15	9.67	4.21	.0152	.0448	.0401	.0047	1.08	.1078	.0016	1.37	-
1914, . . .	.80	10.21	3.14	.0089	.0399	.0339	.0060	1.59	.0195	.0005	1.01	-
1915, . . .	1.62	9.46	4.28	.0118	.0539	.0438	.0101	.87	-	-	1.83	-

Assabet River, above Hudson.

1908, ¹ . . .	.49	5.97	2.16	.0044	.0241	.0200	.0041	.54	.0072	.0003	.59	-
1909, . . .	.39	6.37	2.33	.0070	.0306	.0261	.0045	.52	.0037	.0002	.50	-
1910, . . .	.57	6.90	3.08	.0058	.0346	.0296	.0050	.61	.0055	.0002	.67	-
1911, . . .	.57	6.82	2.51	.0059	.0295	.0248	.0047	.57	.0077	.0002	.81	-
1912, . . .	.45	6.51	2.13	.0075	.0297	.0234	.0063	.62	.0108	.0002	.59	-
1913, ² . . .	.65	8.48	2.81	.0168	.0386	.0327	.0059	.70	.0046	.0002	.79	-
1914, . . .	.44	6.80	2.10	.0066	.0275	.0222	.0053	.65	.0060	.0001	.53	-
1915, . . .	.82	6.48	2.63	.0064	.0325	.0305	.0020	.55	-	-	1.02	-

¹ September omitted.² November omitted.

CONCORD RIVER.

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES, ETC. — *Continued.**Assabet River, below Hudson.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1898, ...	.79	5.61	2.38	.0062	.0335	.0291	.0044	.39	.0063	.0003	.87	1.6
1899, ...	.50	8.30	3.01	.0205	.0457	.0383	.0074	.80	.0020	.0004	.73	2.1
1900, ...	.48	8.05	2.05	.0382	.0501	.0362	.0139	1.27	.0028	.0007	.72	2.0
1901, ...	.66	5.47	2.38	.0193	.0375	.0295	.0080	.79	.0107	.0005	.91	1.8
1902, ...	.64	7.06	2.69	.0189	.0464	.0330	.0134	.84	.0077	.0005	.74	1.9
1903, ¹	.51	5.71	2.17	.0092	.0287	.0222	.0065	.56	.0073	.0006	.60	1.7
1904, ²	.44	7.67	2.60	.0329	.0375	.0312	.0063	1.43	.0073	.0005	.64	1.9
1908, ...	.51	9.17	3.50	.0198	.0396	.0294	.0102	1.32	.0072	.0005	.82	—
1909, ...	.51	8.81	3.26	.0161	.0403	.0296	.0107	.98	.0022	.0002	.64	—
1910, ...	.69	13.83	3.83	.0413	.0428	.0337	.0091	1.27	.0048	.0002	1.24	—
1911, ...	.64	12.83	4.30	.0817	.0532	.0400	.0132	.90	.0043	.0003	1.06	—
1912, ...	.78	18.08	3.99	.0939	.0752	.0494	.0258	1.02	.0053	.0002	1.28	—
1913, ³	.76	13.29	3.34	.0727	.0704	.0577	.0127	1.07	.0036	.0004	1.28	—
1914, ...	.57	11.88	3.10	.0720	.0601	.0436	.0165	.98	.0042	.0002	1.03	—
1915, ...	.90	8.25	3.17	.0144	.0466	.0356	.0110	.59	—	—	1.16	—

¹ June omitted.² Three months.³ November omitted.*Assabet River, above Maynard.*

1904, ...	.53	5.65	2.30	.0046	.0275	.0231	.0044	.64	.0035	.0001	.63	1.6
1906, ...	.75	5.53	2.26	.0065	.0290	.0254	.0036	.48	.0035	.0002	.97	1.5
1907, ¹	.68	5.35	1.80	.0047	.0255	.0211	.0044	.50	.0043	.0002	.73	1.6
1908, ...	.52	6.91	2.32	.0093	.0288	.0248	.0040	1.03	.0030	.0002	.62	-
1909, ...	.43	6.18	2.13	.0068	.0343	.0277	.0066	.72	.0023	.0001	.62	-
1910, ...	.54	7.70	2.82	.0098	.0337	.0291	.0046	.98	.0017	.0003	.64	-
1911, ...	.57	7.67	2.33	.0087	.0327	.0277	.0050	.85	.0065	.0004	.73	-
1912, ...	.57	7.92	2.15	.0058	.0316	.0242	.0074	1.06	.0032	.0002	.65	-
1913, ...	.60	7.85	2.27	.0085	.0372	.0296	.0076	1.03	.0028	.0003	.73	-
1914, ...	.46	7.02	2.39	.0069	.0373	.0308	.0065	.82	.0014	.0002	.53	-
1915, ...	.92	7.08	2.63	.0104	.0403	.0336	.0067	.63	-	-	1.03	-

¹ Four months.

CONCORD RIVER.

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES, ETC. — *Concluded.**Assabet River, below Maynard.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1898, ...	.77	5.93	2.59	.0020	.0387	.0301	.0086	.43	.0030	.0003	.89	1.5
1899, ...	.51	6.70	2.21	.0185	.0414	.0327	.0087	.73	.0043	.0003	.62	1.7
1900, ...	.50	5.72	1.73	.0217	.0386	.0304	.0082	.70	.0031	.0002	.59	1.4
1901, ...	.73	6.57	2.67	.0211	.0428	.0351	.0077	.45	.0052	.0002	.90	1.6
1902, ...	.69	7.27	2.87	.0099	.0592	.0381	.0211	.57	.0033	.0002	.83	1.6
1903, ...	.61	6.40	2.58	.0170	.0457	.0322	.0135	.48	.0037	.0003	.83	1.6
1904, ...	—	8.48	3.21	.0143	.0678	.0412	.0266	.74	.0043	.0002	1.05	1.7
1906, ...	.88	6.68	2.64	.0290	.0448	.0312	.0136	.58	.0047	.0003	.91	1.6
1907, ¹	.79	7.64	2.76	.0299	.0391	.0274	.0117	.69	.0060	.0003	.86	1.6
1908, ...	.45	11.46	3.98	.0675	.0684	.0381	.0303	1.37	.0028	.0012	.89	—
1909, ...	—	13.97	4.21	.1208	.0991	.0529	.0462	1.22	.0007	.0006	1.34	—
1910, ...	.59	13.15	4.68	.0708	.0685	.0446	.0239	1.82	.0038	.0006	.85	—
1911, ...	.58	12.73	4.17	.0738	.0650	.0408	.0242	1.41	.0060	.0006	1.08	—
1912, ...	—	12.94	3.92	.1205	.0771	.0494	.0277	1.46	.0026	.0010	1.04	—
1913, ...	.60	10.60	3.01	.0746	.0597	.0394	.0203	1.34	.0311	.0007	.85	—
1914, ...	.33	11.58	2.87	.0705	.0595	.0378	.0217	1.32	.0056	.0002	.73	—
1915, ...	.69	10.78	3.25	.0509	.0610	.0353	.0257	1.27	—	—	.99	—

¹ Four months.*Concord River, at Billerica.*

1902, ...	.68	5.98	2.18	.0091	.0347	.0272	.0075	.53	.0052	.0004	.78	1.7
1903, ...	.64	5.71	2.26	.0097	.0317	.0258	.0059	.49	.0058	.0005	.72	1.8
1904, ...	.64	6.05	2.31	.0077	.0341	.0255	.0086	.55	.0072	.0002	.75	1.7
1908, ...	.37	8.04	2.65	.0107	.0251	.0216	.0035	.96	.0104	.0005	.54	—
1909, ...	.49	7.71	2.73	.0128	.0298	.0267	.0031	.75	.0058	.0013	.65	—
1910, ...	.49	7.31	3.00	.0142	.0325	.0292	.0033	1.01	.0055	.0004	.58	—
1911, ...	.45	11.14	4.05	.0181	.0525	.0287	.0238	1.16	.0132	.0008	1.14	—
1912, ¹	.53	10.90	3.08	.0187	.0433	.0274	.0159	.97	.0140	.0008	.82	—
1913, ...	.57	7.63	2.38	.0089	.0355	.0312	.0043	.98	.0073	.0003	.77	—
1914, ...	.41	8.78	2.20	.0096	.0335	.0284	.0051	1.10	.0072	.0005	.50	—
1915, ...	.88	7.92	2.93	.0157	.0411	.0375	.0036	.84	—	—	1.05	—

¹ September omitted.

CONNECTICUT RIVER.

A general statement of the condition of this river during the year 1915 will be found on page 58.

CONNECTICUT RIVER.

CHEMICAL EXAMINATION OF WATER FROM CONNECTICUT RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Connecticut River, at Northfield Farms.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1899.	.30	7.32	2.17	.0016	.0189	.0158	.0031	.11	.0023	.0001	.85	3.6
1900.	.47	6.24	2.11	.0023	.0190	.0154	.0036	.09	.0030	.0001	.95	2.9
1901.	.31	6.12	2.39	.0016	.0146	.0122	.0024	.10	.0037	.0002	.72	3.2
1902.	.30	5.57	2.02	.0014	.0124	.0110	.0014	.08	.0057	.0001	.60	2.9
1903.	.23	6.83	2.18	.0037	.0169	.0143	.0026	.14	.0028	.0002	.68	3.4
1904. ¹	.27	6.44	2.44	.0023	.0158	.0130	.0028	.12	.0038	.0001	.73	3.4
1906.	.34	6.50	2.17	.0040	.0201	.0181	.0020	.14	.0023	.0002	.76	3.2
1907. ²	.36	5.91	2.06	.0020	.0141	.0122	.0019	.16	.0048	.0002	.66	3.0
1908. ³	.28	8.33	2.78	.0058	.0200	.0177	.0023	.22	.0018	.0001	.70	—
1909.	.29	7.32	2.89	.0031	.0142	.0124	.0018	.16	.0017	.0002	.82	—
1910.	.31	7.52	3.10	.0064	.0174	.0152	.0022	.17	.0018	.0001	.77	—
1911.	.32	7.28	2.44	.0066	.0172	.0143	.0029	.16	.0022	.0001	.70	—
1912.	.36	7.43	1.63	.0066	.0185	.0148	.0037	.16	.0012	.0001	.70	—
1913.	.31	7.78	2.31	.0077	.0174	.0131	.0043	.17	.0020	.0002	.65	—
1914.	.29	8.03	2.73	.0056	.0182	.0137	.0045	.17	.0012	.0001	.70	—
1915.	.30	7.08	2.08	.0031	.0162	.0124	.0038	.17	—	—	.60	—

¹ July omitted.

² Four months.

³ June omitted.

Connecticut River, below Springfield.

1888, ...	.35	5.34	1.24	.0032	.0182	.0143	.0039	.15	.0082	.0002	—	—
1899, ...	.33	6.61	1.99	.0093	.0238	.0195	.0043	.23	.0042	.0003	.67	3.1
1900, ...	.44	6.64	1.90	.0098	.0250	.0176	.0074	.20	.0034	.0002	.89	3.1
1901, ...	.32	6.03	2.34	.0061	.0190	.0153	.0037	.18	.0048	.0003	.65	3.0
1902, ...	.31	5.83	2.13	.0062	.0180	.0140	.0040	.16	.0055	.0005	.61	3.0
1903, ...	.30	6.12	2.04	.0098	.0202	.0147	.0055	.24	.0058	.0004	.61	2.7
1904, ¹	.22	5.22	1.87	.0098	.0187	.0125	.0062	.21	.0047	.0002	.48	2.4
1906, ²	.35	7.14	2.61	.0082	.0204	.0161	.0043	.24	.0026	.0004	.71	2.8
1907, ³	.38	6.27	2.46	.0069	.0163	.0131	.0032	.24	.0050	.0003	.67	2.9
1908, ...	.32	8.58	2.61	.0214	.0223	.0165	.0058	.38	.0040	.0004	.81	—
1909, ...	.29	6.02	2.25	.0079	.0156	.0118	.0038	.22	.0018	.0003	.65	—
1910, ...	.33	8.67	3.60	.0155	.0241	.0188	.0053	.37	.0028	.0003	.89	—
1911, ...	.38	7.66	2.56	.0140	.0181	.0147	.0034	.28	.0018	.0005	.70	—
1912, ...	.31	8.22	3.02	.0136	.0228	.0161	.0067	.16	.0022	.0004	.74	—
1913, ⁴	.31	7.96	2.50	.0178	.0242	.0181	.0061	.35	.0038	.0004	.68	—
1914, ...	.29	7.92	2.50	.0185	.0243	.0178	.0065	.30	.0023	.0003	.82	—
1915, ...	.35	7.15	2.38	.0091	.0216	.0151	.0065	.24	—	—	.69	—

¹ Three months.

² June omitted.

³ Four months.

⁴ September omitted.

DEERFIELD RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 61.

DEERFIELD RIVER.

CHEMICAL EXAMINATION OF WATER FROM DEERFIELD RIVER AND TRIBUTARY.

— AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Deerfield River, at Shelburne Falls.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1901,	.34	4.02	1.82	.0057	.0200	.0171	.0029	.09	.0078	.0001	.63	1.7
1902,	.29	3.62	1.46	.0051	.0151	.0126	.0025	.08	.0055	.0002	.51	1.7
1903, ¹	.26	3.74	1.35	.0023	.0131	.0113	.0018	.09	.0038	.0002	.44	1.5
1904,	.24	4.15	1.52	.0040	.0115	.0097	.0018	.11	.0110	.0001	.39	2.1
1908,	.33	4.93	1.93	.0017	.0128	.0108	.0020	.14	.0030	.0001	.44	—
1909,	.26	4.56	1.62	.0009	.0150	.0129	.0021	.12	.0005	.0001	.47	—
1910,	.26	4.62	1.69	.0025	.0141	.0108	.0033	.13	.0010	.0001	.45	—
1911,	.35	4.80	1.88	.0035	.0156	.0119	.0037	.13	.0027	.0000	.59	—
1912, ²	.29	4.48	1.65	.0024	.0149	.0122	.0027	.11	.0008	.0001	.42	—
1913,	.39	4.55	1.30	.0049	.0213	.0164	.0049	.12	.0007	.0000	.53	—
1914,	.45	4.80	1.57	.0062	.0222	.0167	.0055	.17	.0022	.0003	.56	—
1915,	.27	4.58	1.44	.0042	.0149	.0121	.0028	.16	—	—	.39	—

¹ Four months.

² October omitted.

Green River, below Greenfield.

1903, ...	.05	7.75	2.23	.0152	.0143	.0086	.0057	.21	.0078	.0005	.15	3.9
1904, ...	.07	6.93	2.01	.0151	.0382	.0138	.0244	.28	.0100	.0006	.22	3.8
1908, ...	.17	11.06	2.97	.0665	.0337	.0131	.0206	.45	.0043	.0011	.33	—
1909, ...	.14	7.82	2.54	.0459	.0333	.0151	.0182	.37	.0038	.0011	.23	—
1910, ...	.17	8.33	3.16	.0775	.0284	.0169	.0115	.37	.0025	.0012	.23	—
1911, ...	.21	9.23	2.44	.0684	.0228	.0115	.0113	.48	.0033	.0014	.37	—
1912, ...	.17	18.02	2.71	.0099	.0352	.0092	.0260	.23	.0017	.0003	.44	—
1913, ...	.12	8.25	2.25	.0203	.0198	.0103	.0095	.26	.0030	.0003	.22	—
1914, ...	.13	9.15	1.60	.0426	.0234	.0135	.0099	.38	.0038	.0007	.17	—
1915, ¹	.10	6.95	1.15	.0348	.0184	.0102	.0082	.28	—	—	.20	—

¹ Four months.

Deerfield River, below Green River.

1908, ...	.26	7.35	2.28	.0075	.0154	.0098	.0056	.20	.0025	.0002	.37	—
1909, ...	.28	5.55	1.83	.0043	.0121	.0104	.0017	.14	.0012	.0001	.41	—
1910, ...	.24	5.82	2.37	.0093	.0128	.0112	.0016	.16	.0008	.0003	.31	—
1911, ...	.34	5.82	2.06	.0078	.0143	.0106	.0037	.16	.0025	.0005	.52	—
1912, ...	.25	5.23	1.63	.0070	.0140	.0107	.0033	.17	.0030	.0001	.37	—
1913, ...	.28	5.39	1.60	.0113	.0257	.0183	.0074	.17	.0063	.0002	.39	—
1914, ...	.30	5.68	1.80	.0124	.0182	.0143	.0039	.19	.0020	.0001	.43	—
1915, ¹	.22	5.41	1.28	.0211	.0195	.0128	.0067	.20	—	—	.34	—

¹ Four months.

FRENCH RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 58.

FRENCH RIVER.

CHEMICAL EXAMINATION OF WATER FROM FRENCH RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

French River, below Webster.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.		Nitrates.		Nitrites.			
					Total.	Dissolved.				Suspended.		
1899, . . .	.44	5.67	2.07	.0238	.0612	.0384	.0228	.42	.0024	.0007	.66	1.6
1900, . . .	.52	5.79	2.10	.0202	.0475	.0357	.0118	.46	.0062	.0007	.78	1.5
1901, . . .	.50	5.29	2.25	.0090	.0390	.0265	.0125	.33	.0044	.0002	.75	1.2
1902, . . .	.42	4.92	1.99	.0057	.0391	.0264	.0127	.39	.0038	.0002	.65	1.2
1903, . . .	.48	4.67	1.88	.0049	.0352	.0241	.0111	.40	.0058	.0002	.72	0.9
1904, . . .	.44	6.02	2.18	.0267	.0434	.0281	.0153	.58	.0042	.0004	.70	1.3
1906, . . .	.61	5.08	2.19	.0063	.0353	.0246	.0107	.40	.0038	.0003	.81	0.9
1907, ¹ . . .	.54	6.28	2.62	.0117	.0544	.0304	.0240	.49	.0035	.0004	.69	1.2
1908, . . .	.44	7.17	2.82	.0086	.0507	.0310	.0197	.61	.0037	.0010	.81	—
1909, . . .	.50	7.42	2.61	.0267	.0638	.0385	.0253	.77	.0055	.0012	.72	—
1910, . . .	.44	8.27	3.55	.0512	.0527	.0321	.0206	.78	.0016	.0021	.79	—
1911, . . .	.57	10.23	3.17	.0219	.0652	.0405	.0247	.89	.0015	.0004	.94	—
1912, . . .	.49	9.78	3.77	.0420	.0745	.0399	.0346	.82	.0060	.0021	.87	—
1913, . . .	.53	8.42	2.93	.0345	.0641	.0358	.0283	.72	.0042	.0007	.86	—
1914, . . .	.40	8.50	2.48	.0500	.0675	.0399	.0276	.72	.0018	.0027	.69	—
1915, . . .	.53	8.38	3.02	.0472	.0778	.0448	.0330	.80	—	—	.88	—

¹ Four months.

HOOSICK RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 59.

HOOSICK RIVER.

CHEMICAL EXAMINATION OF WATER FROM HOOSICK RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Hoosick River, at Williamstown.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.			Nitrates.		Nitrites.			
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.				Suspended.		
1887, ...	.22	12.05	1.22	.0065	.0190	-	-	.23	.0232	-	-	-
1888, ...	.12	10.82	1.90	.0026	.0210	.0142	.0068	.27	.0247	.0015	-	-
1894, ...	.37	13.56	2.74	.0166	.0361	.0224	.0137	.50	.0102	.0014	.42	9.0
1895, ...	.34	14.20	3.26	.0190	.0424	.0241	.0183	.63	.0090	.0020	.53	9.0
1896, ...	.21	11.71	2.39	.0295	.0267	.0172	.0095	.39	.0133	.0018	.33	8.6
1897, ...	.26	11.32	2.39	.0174	.0312	.0173	.0139	.30	.0265	.0011	.31	7.9
1898, ...	.27	10.46	2.38	.0223	.0311	.0210	.0101	.31	.0170	.0007	.34	6.6
1899, ...	.30	15.21	3.31	.0252	.0622	.0379	.0243	.64	.0070	.0029	.62	8.3
1900, ...	.28	14.20	2.79	.0433	.0547	.0301	.0246	.60	.0087	.0043	.58	7.8
1901, ...	.27	13.02	3.70	.0400	.0520	.0250	.0270	.43	.0152	.0024	.53	7.3
1902, ...	.22	10.62	2.87	.0069	.0307	.0172	.0135	.34	.0123	.0014	.40	6.4
1903, ...	.17	10.50	2.37	.0272	.0264	.0151	.0113	.29	.0183	.0019	.33	7.5
1904, ...	.13	12.30	3.23	.0677	.0310	.0191	.0119	.45	.0203	.0024	.29	8.3
1905, ...	.20	11.09	2.81	.0295	.0265	.0156	.0109	.32	.0123	.0015	.31	5.6
1906, ...	.31	13.28	3.63	.0415	.0489	.0252	.0237	.47	.0147	.0030	.43	6.0
1907, ...	.25	11.80	2.93	.0431	.0390	.0231	.0159	.47	.0135	.0021	.39	7.9
1908, ...	.23	14.00	3.86	.0559	.0323	.0195	.0128	.54	.0085	.0023	.37	-
1909, ...	.23	15.46	4.09	.0496	.0382	.0243	.0139	.62	.0060	.0035	.41	-
1910, ...	.30	13.06	4.43	.0320	.0336	.0219	.0117	.52	.0102	.0018	.41	-
1911, ...	.26	12.38	3.77	.1153	.0492	.0232	.0260	.58	.0065	.0022	.43	-
1912, ...	.24	15.05	3.35	.0365	.0464	.0280	.0184	.73	.0058	.0025	.45	9.3
1913, ...	.13	17.57	3.78	.0638	.0489	.0310	.0179	.88	.0053	.0024	.49	9.2
1914, ...	.39	18.62	4.02	.0670	.0584	.0381	.0203	.83	.0037	.0015	.63	9.5
1915, ...	.21	12.65	2.60	.0351	.0316	.0202	.0114	.49	-	-	.32	6.9

HOUSATONIC RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 59.

HOUSATONIC RIVER.

CHEMICAL EXAMINATION OF WATER FROM HOUSATONIC RIVER AND ITS BRANCHES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

East Branch, below Pittsfield.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1903, . . .	.32	9.75	2.92	.0118	.0226	.0153	.0073	.25	.0142	.0006	.56	6.8
1904, ¹ . . .	.28	9.02	3.15	.0117	.0248	.0175	.0073	.26	.0113	.0005	.47	6.2
1907, ² . . .	.42	9.40	3.00	.0286	.0284	.0186	.0098	.28	.0060	.0010	.50	6.4
1908, ³ . . .	.29	12.76	3.57	.0327	.0250	.0177	.0073	.40	.0140	.0011	.47	-
1909, . . .	.26	12.60	4.37	.0431	.0305	.0215	.0090	.33	.0087	.0007	.44	-
1910, . . .	.30	12.98	5.26	.0437	.0233	.0182	.0051	.40	.0080	.0012	.48	-
1911, ¹ . . .	.29	12.03	4.26	.0231	.0253	.0169	.0084	.37	.0060	.0011	.54	-
1912, ¹ . . .	.28	13.08	3.18	.0358	.0337	.0236	.0101	.43	.0123	.0010	.62	-
1913, . . .	.32	15.34	3.60	.0526	.0405	.0259	.0146	.48	.0073	.0019	.69	-
1914, ⁴ . . .	.24	13.82	3.27	.0509	.0351	.0271	.0080	.47	.0087	.0015	.53	-
1915, . . .	.37	11.98	3.23	.0527	.0304	.0236	.0068	.35	-	-	.60	-

¹ Three months.² Two months.³ November omitted.⁴ Four months.*West Branch, below Pittsfield.*

1903, . . .	.29	10.43	2.83	.0100	.0210	.0143	.0067	.23	.0143	.0006	.46	7.4
1904, ¹ . . .	.15	12.27	3.50	.0137	.0423	.0217	.0206	.35	.0050	.0004	.35	7.8
1908, ² . . .	.20	13.28	3.68	.0210	.0301	.0194	.0107	.26	.0026	.0009	.36	-
1909, . . .	-	11.00	2.87	.0070	.0283	.0175	.0108	.24	.0010	.0003	.25	-
1910, . . .	.22	13.85	4.98	.0218	.0446	.0218	.0228	.40	.0012	.0011	.40	-
1911, ¹ . . .	.19	12.73	4.70	.0090	.0317	.0184	.0133	.26	.0030	.0005	.37	-
1912, ¹ . . .	.17	12.60	2.70	.0081	.0360	.0197	.0163	.29	.0037	.0005	.41	-
1913, . . .	.30	18.72	5.10	.0870	.0779	.0397	.0382	.78	.0020	.0008	.82	-
1914, ³ . . .	.20	14.62	2.75	.0288	.0495	.0313	.0182	.45	.0017	.0011	.61	-
1915, ⁴ . . .	.34	16.62	3.72	.0671	.0691	.0359	.0332	.65	-	-	.63	-

¹ Three months.² November omitted.³ Four months.⁴ September omitted.

HOUSATONIC RIVER.

CHEMICAL EXAMINATION OF WATER FROM HOUSATONIC RIVER AND ITS BRANCHES, ETC. — *Concluded.**Southwest Branch, at Pittsfield.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1899, ...	.17	14.92	2.58	.0040	.0353	.0211	.0142	.16	.0108	.0004	.37	9.2
1900, ...	.14	14.87	2.15	.0192	.0335	.0229	.0106	.21	.0107	.0008	.35	10.2
1901, ...	.14	13.20	3.87	.0051	.0302	.0197	.0105	.16	.0096	.0004	.41	9.4
1902, ...	.11	12.30	3.09	.0057	.0224	.0136	.0088	.12	.0108	.0005	.37	8.7
1903, ...	.10	11.63	2.37	.0045	.0162	.0109	.0053	.11	.0115	.0003	.25	8.8
1904, ¹	.15	12.45	3.63	.0116	.0455	.0223	.0232	.34	.0040	.0018	.35	7.8
1907, ²	.31	10.78	2.30	.0040	.0258	.0168	.0090	.20	.0025	.0003	.39	8.2
1908, ³	.18	15.17	4.89	.0216	.0269	.0159	.0110	.23	.0036	.0007	.38	—
1909, ...	.17	14.82	4.41	.0041	.0265	.0153	.0112	.23	.0082	.0005	.37	—
1910, ...	.17	14.45	5.25	.0049	.0196	.0135	.0061	.17	.0045	.0006	.30	—
1911, ¹	.14	12.62	3.35	.0013	.0224	.0131	.0093	.19	.0110	.0005	.34	—
1912, ¹	.12	15.02	3.08	.0017	.0172	.0111	.0061	.21	.0170	.0007	.31	—
1913, ...	.13	15.97	3.34	.0037	.0221	.0157	.0064	.20	.0115	.0009	.32	—
1914, ⁴	.16	15.05	2.30	.0098	.0259	.0166	.0093	.24	.0072	.0005	.37	—
1915, ...	.14	15.25	2.95	.0070	.0243	.0159	.0084	.26	—	—	.30	—

¹ Three months.² Two months.³ November omitted.⁴ Four months.*Housatonic River, below Great Barrington.*

1908, . . .	.18	14.97	3.69	.0106	.0269	.0172	.0097	.43	.0107	.0011	.36	—
1909, . . .	.16	14.91	4.41	.0067	.0247	.0173	.0074	.47	.0078	.0012	.35	—
1910, . . .	.22	14.97	5.32	.0128	.0233	.0181	.0052	.51	.0090	.0021	.34	—
1911, . . .	.19	14.42	5.29	.0178	.0217	.0157	.0060	.45	.0087	.0045	.40	—
1912, ¹ . . .	.22	14.56	3.79	.0123	.0272	.0189	.0083	.47	.0120	.0028	.42	—
1913, . . .	.21	18.60	5.48	.0117	.0444	.0265	.0179	.67	.0085	.0030	.77	—
1914, ² . . .	.22	17.62	4.22	.0147	.0372	.0268	.0104	.69	.0112	.0023	.42	—
1915, . . .	.23	15.83	3.60	.0142	.0296	.0183	.0113	.46	—	—	.47	—

¹ August omitted.² Four months.

MERRIMACK RIVER.

A general statement of the condition of this river during the year 1915 will be found on page 59.

MERRIMACK RIVER.

CHEMICAL EXAMINATION OF WATER FROM MERRIMACK RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Merrimack River, above Lowell.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1887.	.45	4.08	1.10	.0024	.0156	—	—	.17	.0078	—	—	—
1888.	.32	3.47	1.01	.0014	.0161	.0137	.0024	.16	.0082	.0002	—	—
1889.	.37	—	—	.0028	.0166	.0143	.0023	.17	.0067	.0001	—	—
1890.	.34	3.85	1.58	.0025	.0148	.0123	.0025	.14	.0106	.0002	—	1.4
1891.	.27	3.73	1.47	.0029	.0147	.0111	.0036	.17	.0080	.0002	—	1.4
1892.	.39	3.75	1.37	.0028	.0139	.0106	.0033	.15	.0097	.0002	—	1.6
1893.	.25	3.47	1.13	.0028	.0141	.0110	.0031	.17	.0072	.0001	.38	1.1
1894.	.29	3.86	1.32	.0037	.0140	.0114	.0026	.19	.0042	.0001	.36	1.2
1895.	.43	3.97	1.61	.0019	.0197	.0151	.0046	.24	.0054	.0001	.55	1.2
1896.	.44	3.85	1.41	.0049	.0181	.0149	.0032	.18	.0053	.0002	.66	1.0
1897.	.54	3.62	1.68	.0030	.0181	.0148	.0033	.16	.0077	.0001	.52	0.9
1898.	.39	3.93	1.74	.0032	.0197	.0171	.0026	.19	.0047	.0001	.51	1.0
1899.	.20	3.88	1.45	.0050	.0205	.0166	.0039	.22	.0055	.0002	.38	1.2
1900.	.23	3.72	1.21	.0068	.0215	.0158	.0057	.23	.0038	.0002	.44	1.3
1901.	.38	4.32	1.98	.0060	.0208	.0172	.0036	.20	.0042	.0002	.69	1.2
1902.	.38	3.81	1.59	.0056	.0163	.0142	.0021	.17	.0043	.0001	.64	0.9
1903.	.30	4.00	1.55	.0058	.0171	.0129	.0042	.23	.0040	.0002	.59	1.1
1904.	.33	4.61	1.92	.0077	.0194	.0153	.0041	.23	.0047	.0002	.69	1.3
1905.	.40	4.30	1.95	.0112	.0202	.0160	.0042	.25	.0038	.0002	.71	1.1
1906.	.37	4.64	1.84	.0100	.0201	.0174	.0027	.26	.0032	.0002	.71	1.2
1907.	.38	4.60	1.88	.0079	.0194	.0135	.0059	.28	.0043	.0002	.62	1.2
1908.	.29	4.67	1.80	.0125	.0195	.0141	.0054	.36	.0048	.0003	.64	1.3
1909.	.31	5.16	2.38	.0185	.0213	.0161	.0052	.36	.0018	.0002	.68	1.5
1910.	.37	5.11	1.78	.0242	.0221	.0180	.0041	.35	.0035	.0007	.68	1.4
1911.	.39	5.32	2.09	.0166	.0219	.0165	.0054	.36	.0033	.0006	.65	1.5
1912.	.40	5.16	1.94	.0165	.0223	.0175	.0048	.32	.0013	.0003	.88	2.0
1913. ¹	.36	5.56	1.66	.0162	.0277	.0189	.0088	.39	.0030	.0003	.70	1.8
1914.	.30	5.32	1.74	.0170	.0255	.0181	.0074	.35	.0037	.0003	.61	1.6
1915.	.46	5.43	2.18	.0140	.0273	.0205	.0068	.32	—	—	.79	1.3

¹ June omitted.

MERRIMACK RIVER.

CHEMICAL EXAMINATION OF WATER FROM MERRIMACK RIVER, ETC. —
*Concluded.**Merrimack River, above Lawrence.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.		Nitrates.		Nitrites.			
					Total.	Dissolved.				Suspended.		
1887, ...	.47	4.82	1.24	.0027	.0211	-	-	.22	.0097	-	-	-
1888, ...	.32	3.64	1.13	.0029	.0197	.0153	.0044	.18	.0074	.0003	-	-
1889, ...	.35	-	-	.0047	.0212	.0176	.0036	.20	.0053	.0002	-	-
1890, ...	.37	4.27	1.56	.0061	.0187	.0148	.0039	.19	.0068	.0002	-	1.6
1891, ...	.21	4.06	1.37	.0066	.0179	.0138	.0041	.21	.0090	.0002	-	1.4
1892, ...	.46	4.25	1.50	.0054	.0186	.0155	.0031	.19	.0087	.0002	-	1.5
1893, ...	.40	4.25	1.62	.0084	.0172	.0138	.0034	.23	.0057	.0003	.52	1.3
1894, ...	.32	3.82	1.35	.0086	.0174	.0142	.0032	.25	.0043	.0001	.40	1.3
1895, ...	.52	4.45	1.97	.0068	.0251	.0194	.0057	.30	.0067	.0003	.60	1.5
1896, ...	.46	4.24	1.70	.0100	.0224	.0181	.0043	.25	.0067	.0005	.57	1.3
1897, ...	.58	4.06	1.67	.0061	.0222	.0190	.0032	.21	.0053	.0002	.53	1.0
1898, ...	.44	4.46	1.87	.0076	.0262	.0208	.0054	.25	.0050	.0005	.59	1.3
1899, ...	.24	4.42	1.57	.0138	.0277	.0207	.0070	.32	.0052	.0004	.43	1.3
1900, ...	.27	4.22	1.35	.0126	.0249	.0190	.0059	.32	.0050	.0003	.46	1.3
1901, ...	.44	4.73	1.90	.0100	.0280	.0205	.0075	.28	.0070	.0006	.65	1.5
1902, ...	.42	4.40	1.85	.0110	.0231	.0180	.0051	.26	.0038	.0003	.65	1.1
1903, ...	.37	4.66	1.73	.0111	.0226	.0166	.0060	.31	.0052	.0005	.64	1.4
1904, ...	.31	4.67	1.80	.0211	.0247	.0170	.0077	.33	.0053	.0004	.62	1.4
1905, ...	.44	4.92	2.01	.0177	.0242	.0183	.0059	.38	.0040	.0005	.74	1.2
1906, ...	.39	5.30	2.12	.0170	.0263	.0215	.0048	.40	.0027	.0005	.72	1.4
1907, ...	.40	4.92	1.80	.0293	.0253	.0175	.0078	.41	.0047	.0005	.59	1.3
1908, ...	.33	5.61	2.19	.0354	.0303	.0196	.0107	.57	.0052	.0006	.74	1.5
1909, ...	.33	6.28	2.04	.0336	.0262	.0196	.0066	.53	.0025	.0007	.67	1.7
1910, ...	.39	-	-	.0266	.0242	.0183	.0059	.53	.0125	.0008	.57	1.6
1911, ...	.23	8.22	3.10	.0240	.0286	.0227	.0059	.53	.0118	.0007	.65	1.6
1912, ...	.21	6.49	2.62	.0241	.0225	.0188	.0037	.52	.0151	.0006	.59	1.3
1913, ...	.25	7.46	2.93	.0245	.0224	.0185	.0039	.57	.0167	.0007	.61	1.5
1914, ...	.23	6.85	2.62	.0280	.0246	.0201	.0045	.59	.0190	.0003	.59	1.7
1915, ...	.33	7.05	2.83	.0183	.0230	.0177	.0053	.47	.0139	.0002	.69	1.6

MILLER'S RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 61.

MILLER'S RIVER.

CHEMICAL EXAMINATION OF WATER FROM MILLER'S RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Miller's River, below Miller's Falls.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1908, ...	.54	4.59	2.06	.0054	.0233	.0181	.0052	.34	.0060	.0002	.64	-
1909, ...	.54	4.38	1.84	.0035	.0207	.0181	.0026	.34	.0030	.0002	.60	-
1910, ...	.55	5.48	2.28	.0068	.0231	.0202	.0029	.44	.0075	.0002	.68	-
1911, ...	.66	5.98	2.58	.0056	.0258	.0220	.0038	.35	.0052	.0002	.90	-
1912, ...	.51	5.30	2.17	.0047	.0242	.0202	.0040	.42	.0060	.0002	.61	-
1913, ...	.59	5.65	1.88	.0056	.0315	.0231	.0084	.36	.0081	.0002	.69	-
1914, ...	.44	5.17	1.85	.0073	.0251	.0204	.0047	.36	.0068	.0003	.49	-
1915, ...	.88	5.77	2.75	.0092	.0311	.0256	.0055	.31	-	-	.93	-

NASHUA RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 60.

NASHUA RIVER.

CHEMICAL EXAMINATION OF WATER FROM NASHUA RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

North Branch of Nashua River, below Fitchburg.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1893, ...	.70	8.32	2.38	.0562	.0405	.0289	.0116	.73	.0097	.0030	.73	2.2
1894, ...	.66	9.18	2.22	.0987	.0425	.0308	.0117	.99	.0123	.0034	.64	2.4
1895, ...	.71	9.42	2.72	.1387	.0493	.0381	.0112	1.08	.0088	.0014	.82	2.6
1896, ...	.57	9.27	2.62	.0898	.0537	.0384	.0153	.95	.0127	.0030	.71	2.4
1897, ...	.67	7.62	2.50	.0512	.0518	.0389	.0129	.71	.0112	.0009	.79	2.1
1898, ...	.56	7.02	2.37	.0688	.0629	.0399	.0230	.56	.0097	.0016	.72	1.8
1899, ...	.53	10.12	2.95	.1507	.0848	.0537	.0311	1.03	.0055	.0013	.83	2.4
1900, ...	.42	9.55	2.42	.1575	.0825	.0479	.0346	1.03	.0080	.0015	.73	2.6
1901, ...	.42	8.45	2.58	.0964	.0508	.0347	.0161	.67	.0080	.0013	.69	2.2
1902, ...	.39	7.83	2.42	.1070	.0557	.0407	.0150	.68	.0072	.0012	.71	1.9
1903, ...	.38	7.21	2.10	.1200	.0471	.0281	.0190	.73	.0095	.0014	.62	1.7
1904, ...	.33	9.05	2.70	.1858	.0596	.0341	.0255	.88	.0077	.0015	.70	2.1
1905, ...	.48	7.66	2.33	.1284	.0568	.0354	.0214	.73	.0053	.0008	.89	2.1
1906, ...	.47	7.68	2.16	.1037	.0558	.0356	.0202	.75	.0083	.0020	.68	2.0
1907, ...	.50	10.77	2.72	.2180	.0654	.0350	.0304	1.24	.0065	.0012	.72	2.8
1908, ...	.52	15.05	3.60	.2605	.0861	.0494	.0367	1.58	.0033	.0016	1.04	—
1909, ...	.52	15.85	3.42	.3220	.0958	.0563	.0395	1.87	.0027	.0014	1.02	—
1910, ...	.60	20.11	4.90	.4047	.1235	.0789	.0446	2.29	.0017	.0009	1.03	—
1911, ...	.51	19.38	5.57	.2848	.1035	.0566	.0469	2.37	.0027	.0015	1.15	—
1912, ...	.57	19.52	4.99	.2380	.1007	.0560	.0447	2.20	.0032	.0019	1.22	—
1913, ...	.40	23.45	4.97	.2770	.1064	.0561	.0503	2.02	.0028	.0013	1.42	5.0
1914, ...	.41	26.93	5.78	.3260	.1156	.0662	.0494	2.60	.0020	.0006	1.55	5.9
1915, ¹	.41	14.68	3.52	.0578	.0745	.0296	.0449	1.26	—	—	.94	3.1

¹ October omitted.

NASHUA RIVER.

CHEMICAL EXAMINATION OF WATER FROM NASHUA RIVER, ETC. — *Concluded.**North Branch of Nashua River, at Lancaster.*

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
				ALBUMINOID.			Nitrates.		Nitrites.			
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.				Suspended.		
1892.	.48	9.75	2.10	.0422	.0274	.0237	.0037	1.11	.0450	.0010	—	3.0
1894.	.49	8.07	1.97	.0215	.0226	.0182	.0044	.97	.0295	.0011	.49	2.2
1895.	.51	8.28	2.39	.0318	.0272	.0214	.0058	1.01	.0284	.0034	.56	2.3
1896.	.57	6.97	2.17	.0253	.0322	.0253	.0069	.66	.0167	.0034	.60	2.0
1897.	.65	5.45	2.03	.0225	.0290	.0221	.0069	.40	.0153	.0015	.68	1.5
1898.	.48	6.33	2.10	.0409	.0345	.0263	.0082	.56	.0227	.0033	.51	1.7
1899.	.39	7.60	2.33	.0739	.0365	.0305	.0060	.75	.0153	.0028	.60	2.0
1900.	.29	7.17	1.55	.0545	.0326	.0264	.0062	.81	.0202	.0039	.52	2.1
1901.	.37	6.72	2.14	.0432	.0329	.0240	.0089	.54	.0087	.0021	.58	1.9
1902.	.40	7.96	2.66	.0757	.0324	.0267	.0057	.70	.0188	.0043	.58	1.8
1903.	.36	6.95	2.35	.0473	.0260	.0201	.0059	.58	.0258	.0034	.52	1.6
1904.	.32	8.01	2.18	.0803	.0318	.0267	.0051	.80	.0267	.0040	.53	2.0
1905.	.34	7.20	2.13	.0616	.0296	.0227	.0069	.70	.0207	.0044	.50	1.9
1906.	.44	7.34	2.12	.0519	.0311	.0240	.0071	.72	.0238	.0027	.56	2.0
1907.	.44	8.34	2.33	.0600	.0294	.0232	.0062	.89	.0333	.0084	.53	2.1
1908.	.40	10.69	2.73	.1075	.0309	.0259	.0050	1.28	.0405	.0090	.58	—
1909.	.44	12.26	3.41	.1556	.0330	.0284	.0046	1.46	.0360	.0066	.60	—
1910.	.45	13.44	3.82	.1655	.0462	.0366	.0096	1.63	.0388	.0108	.70	—
1911.	.51	15.64	4.10	.3067	.0828	.0408	.0420	1.95	.0208	.0083	.92	—
1912.	.45	12.65	3.10	.1252	.0438	.0275	.0163	1.68	.0343	.0083	.72	—
1913.	.43	15.45	3.02	.2292	.0533	.0386	.0147	1.75	.0133	.0053	.80	4.2
1914.	.39	16.80	3.15	.2147	.0466	.0336	.0130	1.94	.0262	.0115	.67	4.1
1915.	.42	12.10	3.49	.0757	.0465	.0294	.0171	1.31	—	—	.68	2.4

Nashua River, at Pepperell.

1899, ...	.28	6.91	2.19	.0167	.0248	.0221	.0027	.78	.0137	.0008	.46	2.1
1901, ...	.37	6.00	2.06	.0154	.0266	.0230	.0036	.45	.0092	.0005	.55	1.9
1902, ...	.37	5.81	2.07	.0118	.0184	.0167	.0017	.49	.0162	.0006	.51	1.7
1903, ...	.35	5.15	1.57	.0097	.0180	.0152	.0028	.44	.0128	.0008	.55	1.6
1904, ¹	.30	6.23	1.93	.0111	.0206	.0171	.0035	.58	.0243	.0008	.44	1.9
1908, ...	.32	10.85	3.40	.0317	.0295	.0202	.0093	1.45	.0194	.0008	.63	—
1909, ...	.38	14.29	4.62	.0354	.0376	.0291	.0085	1.95	.0211	.0017	.92	—
1910, ...	.37	14.77	4.14	.0128	.0329	.0252	.0077	1.93	.0207	.0008	.81	—
1911, ...	.40	12.10	3.77	.0423	.0393	.0293	.0100	1.31	.0213	.0048	.62	—
1912, ²	.48	12.52	3.28	.0223	.0409	.0254	.0155	1.46	.0204	.0017	.75	—
1913, ³	.43	11.99	2.79	.0515	.0405	.0276	.0129	1.15	.0164	.0019	.73	—
1914, ⁴	.31	12.67	2.75	.0595	.0459	.0286	.0173	1.27	.0132	.0027	.59	—
1915, ...	.46	8.25	2.27	.0222	.0328	.0237	.0091	.85	—	—	.63	—

¹ Three months.² November omitted.³ Four months.⁴ Two months.

NEPONSET RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 60.

NEPONSET RIVER.

CHEMICAL EXAMINATION OF WATER FROM NEPONSET RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Neponset River, at Hyde Park.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1887, . . .	1.18	8.20	2.22	.0053	.0402	-	-	.98	.0077	-	-	-
1888, . . .	1.12	7.77	2.37	.0040	.0392	.0358	.0034	1.08	.0074	.0003	-	-
1893, . . .	1.27	8.60	2.68	.0233	.0370	.0282	.0088	1.47	.0045	.0009	1.00	2.6
1894, . . .	1.19	12.87	3.03	.0196	.0466	.0333	.0133	2.31	.0033	.0002	1.03	4.1
1895, . . .	.97	10.01	3.07	.0341	.0440	.0373	.0067	1.51	.0042	.0001	1.05	3.7
1896, . . .	1.26	10.41	3.12	.0162	.0431	.0395	.0036	1.68	.0033	.0001	1.26	3.3
1897, . . .	1.30	11.64	3.34	.0336	.0494	.0417	.0077	1.81	.0037	.0001	1.31	4.0
1898, . . .	1.28	8.82	3.52	.0161	.0505	.0398	.0107	1.02	.0023	.0002	1.30	2.7
1899, . . .	1.14	16.24	4.51	.0264	.0936	.0693	.0243	2.20	.0032	.0002	1.76	5.7
1900, . . .	1.10	10.59	2.99	.0400	.0576	.0381	.0195	1.45	.0048	.0005	1.07	3.2
1901, . . .	1.43	13.26	5.09	.0224	.0802	.0591	.0211	1.69	.0036	.0006	1.82	4.2
1902, . . .	1.02	12.57	4.19	.0360	.0640	.0547	.0093	1.72	.0035	.0004	1.29	4.0
1903, . . .	1.29	14.21	4.95	.0278	.0811	.0638	.0173	1.86	.0034	.0010	1.71	4.5
1904, . . .	1.08	16.22	5.68	.0631	.1007	.0777	.0230	2.07	.0037	.0005	1.67	5.6
1905, . . .	1.22	21.88	6.68	.0813	.1043	.0861	.0182	3.44	.0028	.0006	2.22	6.6
1906, . . .	1.35	13.47	4.42	.0549	.0875	.0674	.0201	2.21	.0025	.0008	1.85	3.9
1907, . . .	.90	22.58	6.31	.1201	.1412	.0961	.0451	3.81	.0042	.0004	1.94	6.9
1908, . . .	-	25.40	7.19	.1132	.1209	.0844	.0365	5.08	.0027	.0006	2.01	8.8
1909, . . .	-	28.69	9.08	.1723	.1218	.0898	.0320	5.35	.0027	.0009	2.02	10.0
1910, . . .	-	31.37	10.16	.1740	.1333	.1000	.0333	5.84	.0010	.0002	2.96	10.4
1911, . . .	1.24	18.82	5.49	.0786	.0727	.0539	.0188	3.36	.0025	.0007	1.86	7.1
1912, . . .	.82	26.02	6.45	.1241	.1020	.0707	.0313	4.18	.0017	.0012	2.31	9.2
1913, . . .	1.02	26.13	6.22	.0533	.0757	.0494	.0263	3.93	.0020	.0007	2.29	7.9
1914, . . .	.93	20.27	4.37	.0754	.0697	.0484	.0213	3.43	.0025	.0008	1.31	5.2
1915, ¹ . . .	1.23	19.67	6.30	.0530	.1078	.0649	.0429	2.42	-	-	1.92	5.3

¹ Four months.

QUINEBAUG RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 62.

QUINEBAUG RIVER.

CHEMICAL EXAMINATION OF WATER FROM QUINEBAUG RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Quinebaug River, below Southbridge.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1898, ...	.64	4.18	2.00	.0064	.0372	.0309	.0063	.18	.0050	.0003	.66	0.8
1899, ...	.44	4.32	1.72	.0071	.0298	.0229	.0069	.23	.0048	.0002	.54	1.2
1900, ...	.40	4.31	1.56	.0168	.0324	.0211	.0113	.25	.0024	.0003	.52	1.0
1901, ...	.42	4.52	1.67	.0147	.0232	.0158	.0074	.19	.0050	.0005	.45	1.7
1902, ...	.36	4.12	1.45	.0068	.0224	.0179	.0045	.24	.0054	.0002	.43	1.2
1903, ¹	.39	3.84	1.37	.0076	.0225	.0181	.0044	.24	.0043	.0002	.52	1.0
1904, ...	.40	4.17	1.57	.0086	.0247	.0189	.0058	.26	.0068	.0002	.53	1.2
1908, ...	.46	6.82	2.31	.0075	.0277	.0174	.0103	.33	.0038	.0003	.57	—
1909, ...	.40	5.48	1.99	.0087	.0275	.0219	.0056	.37	.0077	.0003	.56	—
1910, ...	.40	6.20	2.27	.0104	.0334	.0246	.0088	.42	.0032	.0004	.53	—
1911, ¹	.50	5.92	2.09	.0180	.0308	.0240	.0068	.41	.0067	.0002	.66	—
1912, ²	.41	7.35	2.40	.0152	.0397	.0272	.0125	.52	.0025	.0004	.59	—
1913, ¹	.39	6.08	1.88	.0201	.0283	.0219	.0064	.59	.0075	.0007	.53	—
1914, ...	.52	11.93	2.36	.3033	.0514	.0323	.0191	2.41	.0078	.0052	.47	—
1915, ...	.68	7.56	2.49	.1499	.0457	.0327	.0130	.82	—	—	.91	—

¹ Four months.² Two months.

TAUNTON RIVER.

A general statement of the condition of this river and its tributaries in the year 1915 will be found on page 61.

TAUNTON RIVER.

CHEMICAL EXAMINATION OF WATER FROM TAUNTON RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Taunton River, below Taunton.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.							
					Total.	Dissolved.	Suspended.					
1898, . . .	1.56	6.64	3.30	.0109	.0345	.0314	.0031	.61	.0082	.0003	1.51	1.3
1899, . . .	.93	6.31	2.48	.0176	.0317	.0279	.0038	.72	.0060	.0004	1.04	1.2
1900, . . .	.71	6.89	1.91	.0205	.0286	.0258	.0028	1.06	.0112	.0006	.76	1.5
1901, . . .	1.01	6.15	2.45	.0293	.0275	.0255	.0020	.76	.0134	.0005	.92	1.6
1902, ¹ . . .	.94	6.92	2.36	.1902	.0363	.0308	.0055	1.29	.0116	.0012	.90	1.4
1903, . . .	.96	7.06	2.60	.0542	.0270	.0234	.0036	1.10	.0177	.0013	1.02	1.7
1904, . . .	.95	6.49	2.60	.0855	.0319	.0264	.0055	.94	.0137	.0008	1.06	1.3
1906, ² . . .	1.41	7.37	3.11	.0401	.0385	.0331	.0054	.95	.0162	.0008	1.36	1.4
1907, ³ . . .	.94	7.16	2.62	.1031	.0343	.0282	.0061	1.05	.0115	.0009	1.05	1.7
1908, . . .	.73	7.66	2.52	.0469	.0278	.0226	.0052	1.31	.0108	.0011	.74	—
1909, . . .	.90	12.97	3.87	.0416	.0303	.0263	.0040	3.49	.0105	.0014	.88	—
1910, . . .	1.04	19.62	5.69	.0658	.0376	.0305	.0071	6.82	.0110	.0027	.93	—
1911, . . .	1.04	9.65	2.80	.0385	.0330	.0270	.0060	1.73	.0205	.0015	1.04	—
1912, . . .	1.17	10.35	2.95	.0461	.0366	.0295	.0071	1.76	.0173	.0015	1.03	—
1913, . . .	1.09	18.58	4.24	.0506	.0377	.0334	.0043	5.94	.0130	.0015	1.07	—
1914, . . .	.92	18.10	3.33	.0701	.0389	.0323	.0066	5.95	.0100	.0020	.88	—
1915, . . .	1.35	9.38	3.38	.0469	.0465	.0374	.0091	1.24	—	—	1.34	—

¹ September omitted.

² June omitted.

³ Four months.

TEN MILE RIVER.

TEN MILE RIVER.

CHEMICAL EXAMINATION OF WATER FROM TEN MILE RIVER. — AVERAGES
FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Ten Mile River, below Attleboro.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1899, . . .	.71	6.39	2.15	.0072	.0379	.0288	.0091	.62	.0133	.0004	.74	1.7
1900, . . .	.47	6.19	1.60	.0125	.0363	.0241	.0122	.84	.0155	.0004	.49	1.8
1901, . . .	.46	6.09	2.12	.0084	.0290	.0202	.0088	.71	.0222	.0004	.51	1.8
1902, . . .	.41	6.49	1.83	.0073	.0394	.0237	.0157	.88	.0212	.0004	.52	1.9
1903, . . .	.36	7.48	2.39	.0282	.0346	.0200	.0146	.84	.0315	.0020	.53	1.8
1904, . . .	.44	8.89	2.97	.0931	.0527	.0332	.0195	1.03	.0532	.0033	.58	3.5
1906, ¹ . . .	.48	17.57	6.45	.1586	.0914	.0490	.0424	1.07	.0638	.0121	.92	7.9
1907, ¹ . . .	.42	19.07	6.14	.6036	.1471	.0830	.0641	1.73	.2014	.0100	1.18	7.5
1908, . . .	.40	10.89	3.27	.1108	.0483	.0294	.0189	1.37	.0364	.0035	.61	—
1909, . . .	.47	11.23	2.88	.4322	.0626	.0380	.0246	1.51	.0263	.0086	.78	—
1910, . . .	.29	12.05	3.32	.2422	.0545	.0330	.0215	1.98	.0357	.0051	.48	—
1911, . . .	.76	11.94	3.58	.0604	.0506	.0302	.0204	1.55	.0382	.0036	.94	—
1912, . . .	.39	28.98	11.42	.1056	.0750	.0287	.0463	1.92	.0368	.0075	.75	3.6
1913, . . .	.64	13.55	3.33	.0951	.0630	.0303	.0327	1.90	.0242	.0069	.84	—
1914, . . .	.51	15.32	3.09	.1909	.0673	.0401	.0272	1.73	.0300	.0087	.77	—
1915, ¹ . . .	.88	11.10	3.30	.0954	.0494	.0346	.0148	1.37	—	—	.98	3.2

¹ June omitted.

WESTFIELD RIVER.

A general statement of the condition of this river in the year 1915 will be found on page 61.

WESTFIELD RIVER.

CHEMICAL EXAMINATION OF WATER FROM WESTFIELD RIVER. — AVERAGES
FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Westfield River, below Westfield.

[Parts in 100,000.]

YEAR.	Color.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	ALBUMINOID.		Nitrates.		Nitrites.			
					Total.	Dissolved.				Suspended.		
1902, . . .	.22	4.21	1.60	.0062	.0144	.0118	.0026	.14	.0062	.0002	.39	1.9
1903, . . .	.15	3.68	1.30	.0037	.0127	.0105	.0022	.16	.0088	.0003	.28	1.8
1904, . . .	.21	4.16	1.59	.0067	.0152	.0119	.0033	.16	.0068	.0001	.38	1.9
1906, ¹ . . .	.21	4.65	1.48	.0086	.0161	.0135	.0026	.18	.0035	.0003	.29	2.1
1907, . . .	.24	4.49	1.63	.0053	.0137	.0111	.0026	.21	.0075	.0003	.31	2.0
1908, . . .	.17	5.27	2.19	.0218	.0161	.0116	.0045	.27	.0063	.0006	.28	—
1909, . . .	.22	5.56	1.68	.0179	.0187	.0143	.0044	.26	.0075	.0005	.34	—
1910, . . .	.13	6.71	2.39	.0214	.0143	.0120	.0023	.30	.0304	.0010	.21	—
1911, . . .	.25	5.86	2.03	.0272	.0162	.0133	.0029	.28	.0077	.0008	.38	—
1912, ² . . .	.13	6.40	2.08	.0286	.0189	.0130	.0059	.34	.0204	.0014	.24	—
1913, . . .	.23	6.75	1.78	.0247	.0215	.0147	.0068	.30	.0292	.0012	.36	—
1914, . . .	.15	6.50	1.72	.0255	.0255	.0161	.0094	.33	.0101	.0013	.26	—
1915, . . .	.23	5.70	1.78	.0191	.0224	.0159	.0065	.27	—	—	.38	—

¹ Four months.

² September omitted.

WATER SUPPLY STATISTICS.

During the year 1915 water supplies were introduced in the towns of Dartmouth (population 5,330), Groveland (population 2,377), Salisbury (population 1,717) and Shrewsbury (population 2,794).

The water supplied in the town of Dartmouth is obtained from the works of the city of New Bedford, and in Groveland from the works of the city of Haverhill, while in each of the other two towns the water is obtained from independent works. A new water district was established during the year in the town of Easton, to supply the villages of South Easton and Eastondale with water obtained from the works of the city of Brockton.

Of the 353 cities and towns in Massachusetts all of the 35 cities and 176 of the towns are provided with public water supplies. The following table gives a classification by population of the cities and towns having and not having public water supplies at the end of the year: —

POPULATION (1915).	Number of Places of Given Population having Public Water Supplies.	Total Population of Places in Preceding Column.	Number of Places of Given Population not having Public Water Supplies.	Total Population of Places in Preceding Column.
Under 500, ...	—	—	40	13,270
500-999, ...	6	4,569	37	28,196
1,000-1,499, ...	21	27,759	24	29,589
1,500-1,999, ...	12	21,685	20	33,947
2,000-2,499, ...	17	37,819	9	19,992
2,500-2,999, ...	20	54,895	6	16,013
3,000-3,499, ...	6	19,928	3	9,920
3,500-3,999, ...	7	26,444	—	—
Above 4,000, ...	122	3,335,670	3	13,614
Totals, ...	211	3,528,769	142	164,541

The 211 cities and towns having public water supplies are classified in the following table according to the dates when a fairly complete system of water supply was first introduced: —

YEARS.	Number of Public Water Supplies introduced.	YEARS.	Number of Public Water Supplies introduced.
Previous to 1850, ...	5	1890-1899, inclusive, ...	34
1850-1859, inclusive, ...	4	1900-1909, inclusive, ...	21
1860-1869, inclusive, ...	9	1910-1915, inclusive (six years), ...	23
1870-1879, inclusive, ...	45	Total, ...	211
1880-1889, inclusive, ...	70		

The following table gives certain statistics relative to the number of cities and towns and the total population supplied with water from surface and ground-water sources:—

SOURCES OF WATER SUPPLY.	Number of Cities and Towns supplied.	Per Cent. of Cities and Towns supplied.	Population supplied.	Per Cent. of Total Population of All Cities and Towns supplied.
Surface, ...	110	52	2,809,412	80
Ground, ...	78	37	539,165	15
Surface and ground, ...	23	11	180,192	5
Total, ...	211	100	3,528,769	100

The first table presented shows that although but 60 per cent. of the cities and towns in the State are provided with public water supplies, the total population of the places supplied is 96 per cent. of the total population of the State. The populations given in this table were obtained by using the total population of the cities and towns supplied, and are somewhat greater than the actual number of persons to whom the public water supply is available, but the difference is not great. With the exception of the town of Tewksbury, all of the towns in the State having a population in excess of 5,000 are now supplied with water, and there are only 6 towns having a population in excess of 3,000 which are not provided with public water supplies. These towns are as follows:—

TOWN.	Population.	TOWN.	Population.
Tewksbury, ...	5,265	Somerset, ...	3,377
Warren, ...	4,268	Auburn, ...	3,281
Templeton, ...	4,081	Westport, ...	3,262

At the present time the water works are owned either by the municipality or by a water, water supply or fire district in all of the cities and 133 of the towns, while in 43 towns the works are owned by private companies. The following table gives the classification by population of the cities and towns which own their water works and those which are supplied with water by private companies:—

POPULATION IN 1915.	CITIES AND TOWNS OWNING WATER WORKS.		CITIES AND TOWNS SUPPLIED WITH WATER BY PRIVATE COMPANIES.	
	Number.	Total Population.	Number.	Total Population.
Under 1,000, ...	2	1,241	4	3,328
1,000-1,999, ...	23	33,846	10	15,598
2,000-2,999, ...	28	69,407	9	23,307
3,000-3,999, ...	7	25,263	6	21,109
4,000-4,999, ...	7	31,251	2	9,476
5,000-5,999, ...	17	93,855	3	16,117
6,000-6,999, ...	10	66,316	3	18,778
7,000-7,999, ...	7	52,937	—	—
Over 8,000, ...	67	2,979,893	6	67,047
Total, ...	168	3,354,009	43	174,760

The tendency toward municipal ownership of water works is shown in the following table, giving, for the census years since 1890, the total population of all cities and towns supplied with water, the total population of those supplied by private companies and its percentage of the total population of all places supplied:—

YEAR.	Total Population of All Cities and Towns provided with Public Water Supplies.	Population of Towns supplied by Private Companies.	Per Cent. of Total Population supplied with Water.
1890, ...	1,924,812	318,319	16.5
1895, ...	2,237,017	212,579	9.5
1900, ...	2,565,301	236,869	9.2
1905, ...	2,792,490	193,290	6.9
1910, ...	3,171,055	159,730	5.0
1915, ...	3,528,769	174,760	5.0

The foregoing table shows that at the end of the year 1915 the total population of the towns supplied with water by private companies was only 5 per cent. of the total population of all of the cities and towns supplied with water, and there are only 12 towns having a population in excess of 5,000 which are supplied by private companies. These towns are as follows:—

TOWN	Population (1915).	TOWN.	Population (1915).
Southbridge, ...	14,217	Fairhaven, ...	6,277
Milford, ...	13,684	Ludlow, ...	6,251
Dedham, ...	11,043	Grafton, ...	6,250
Palmer, ...	9,468	Amherst, ...	5,558
Bridgewater, ...	9,381	Millbury, ...	5,295
Northbridge, ...	9,254	Hingham, ...	5,264

The population and valuation of all of the cities and towns in Massachusetts in 1915 are given in the following table, which also contains certain information relative to the ownership of the water works and the date of their introduction into those places so provided, the cities and towns being arranged according to their population in 1915:—

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Intro- duction.	Ownership.	With Water Supplies.	Without Water Supplies.	
BOSTON, ...	1848	City, ...	745,439	—	\$1,573,164,500
WORCESTER, ...	1845	City, ...	162,697	—	180,074,186
FALL RIVER, ...	1874	City, ...	124,791	—	107,153,345
NEW BEDFORD, ...	1869	City, ...	109,568	—	111,465,763
CAMBRIDGE, ...	1856	City, ...	108,822	—	130,997,710
LOWELL, ...	1872	City, ...	107,978	—	92,954,197
SPRINGFIELD, ...	1874	City, ...	102,971	—	190,402,170
LYNN, ...	1871	City, ...	95,803	—	92,333,285
LAWRENCE, ...	1875	City, ...	90,259	—	82,785,245
SOMERVILLE, ...	1867	City, ...	86,854	—	77,444,399
BROCKTON, ...	1880	City, ...	62,288	—	54,450,391
HOLYOKE, ...	1873	City, ...	60,816	—	65,551,223
HAYERHILL, ...	1802	City, ...	49,450	—	44,680,117

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Introduc- tion.	Ownership.	With Water Supplies.	Without Water Supplies.	
MALDEN, . . .	1870	City, ...	48,907	-	\$42,925,091
CHELSEA, . . .	1867	City, ...	43,426	-	30,084,560
NEWTON, . . .	1876	City, ...	43,113	-	86,451,659
QUINCY, . . .	1884	City, ...	40,674	-	43,803,965
FITCHBURG, . .	1872	City, ...	39,656	-	40,547,574
PITTSFIELD, . .	1855	City, ...	39,607	-	40,872,870
EVERETT, . . .	1867	City, ...	37,718	-	32,805,950
SALEM, ...	1868	City, ...	37,200	-	43,364,600
TAUNTON, . . .	1876	City, ...	36,161	-	26,832,231
Brookline, . . .	1875	Town, ...	33,490	-	125,759,129
MEDFORD, . . .	1870	City, ...	30,509	-	31,449,950
WALTHAM, . . .	1873	City, ...	30,154	-	31,981,000
CHICOPEE, . . .	1845	City, ...	30,138	-	20,385,240
REVERE, ...	1884	City, ...	25,178	-	23,444,600
GLOUCESTER, . .	1885	City, ...	24,478	-	26,263,201
BEVERLY, . . .	1868	City, ...	22,959	-	44,680,057
NORTH ADAMS, . .	1861	City, ...	22,035	-	16,615,361
NORTHAMPTON, .	1871	City, ...	21,654	-	18,920,031
Peabody, ...	1799	Town, ...	18,625	-	15,135,200
ATTLEBORO, . .	1873	City, ...	18,480	-	22,374,610
Westfield, . . .	1874	Town, ...	18,411	-	12,785,922
Leominster, . . .	1873	Town, ...	17,646	-	13,788,640
MELROSE, . . .	1870	City, ...	16,880	-	19,002,880
Watertown, . . .	1885	Town, ...	16,515	-	19,839,700
WOBURN, ...	1873	City, ...	16,410	-	13,520,865
Gardner, ...	1882	Town, ...	16,376	-	11,543,652
Framingham, . .	1885	Town, ...	15,860	-	17,187,700
NEWBURYPORT, .	1881	City, ...	15,311	-	12,656,186
MARLBOROUGH, .	1883	City, ...	15,250	-	11,307,191
Arlington, . . .	1872	Town, ...	14,889	-	17,771,213
Southbridge, . .	1880	Southbridge Water Supply Com- pany.	14,217	-	8,276,549
Methuen, ...	1875	Town, ...	14,007	-	9,733,743
Weymouth, . . .	1885	Town, ...	13,969	-	12,887,929
Milford, ...	1881	Milford Water Company, . . .	13,684	-	10,472,092
Adams, ...	1874	Adams Fire District, . . .	13,218	-	7,042,971
Clinton, ...	1882	Town, ...	13,192	-	9,470,884
Plymouth, . . .	1855	Town, ...	12,926	-	14,299,615

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Intro- duction.	Ownership.	With Water Supplies.	Without Water Supplies.	
Wakefield, . . .	1883	Town, ...	12,781	-	\$12,452,780
Winthrop, . . .	1884	Town, ...	12,758	-	16,906,450
Greenfield, . . .	1870	Greenfield Fire District No. 1, .	12,618	-	13,700,489
Webster, . . .	1881	Town, ...	12,565	-	9,015,783
West Springfield, .	1875	Town, ...	11,339	-	10,444,515
Danvers, . . .	1876	Town, ...	11,177	-	8,604,150
Natick, . . .	1874	Town, ...	11,119	-	9,293,250
Dedham, . . .	1881	Dedham Water Company, . .	11,043	-	15,990,095
Norwood, . . .	1885	Town, ...	10,977	-	17,053,994
Saugus, . . .	1878	Town, ...	10,226	-	7,137,876
Winchester, . . .	1873	Town, ...	10,005	-	18,920,825
Easthampton, . .	1870	Town, ...	9,845	-	7,856,021
Athol, . . .	1875	Town, ...	9,783	-	6,693,425
Palmer, . . .	1886	Palmer Water Company (Palmer),	9,468	-	5,369,650
	1908	Boston Duck Company (Bonds- ville).			
North Attleborough,	1884	Town, ...	9,398	-	9,562,969
Bridgewater, . . .	1888	Bridgewater Water Company, .	9,381	-	4,239,728
Ware, . . .	1886	Town, ...	9,346	-	5,527,005
Braintree, . . .	1887	Town, ...	9,343	-	9,485,815
Northbridge, . . .	1889	Whitin Machine Works (Whitins- ville).	9,254	-	5,739,990
Middleborough, . .	1885	Middleborough Fire District, .	8,631	-	4,962,035
Milton, . . .	1885	Town, ...	8,600	-	33,681,817
Amesbury, . . .	1885	Town, ...	8,543	-	6,781,910
Belmont, . . .	1887	Town, ...	8,081	-	11,409,543
Andover, . . .	1890	Town, ...	7,978	-	8,944,395
Montague, . . .	1887	Turners Falls Fire District, .	7,925	-	6,003,984
	1896	Millers Falls Water Supply Dis- trict.			
	1909	Lake Pleasant Water Supply Dis- trict.			
Marblehead, . . .	1885	Town, ...	7,606	-	11,460,406
Whitman, . . .	1883	Town, ...	7,520	-	5,759,618
Stoneham, . . .	1883	Town, ...	7,489	-	6,095,860
Swampscott, . . .	1885	Town, ...	7,345	-	15,989,509
Rockland, . . .	1887	Town, ...	7,074	-	5,479,908
Stoughton, . . .	1886	Town, ...	6,982	-	4,350,454
Reading, . . .	1891	Town, ...	6,805	-	7,999,523
Maynard, . . .	1889	Town, ...	6,770	-	4,175,418
Hudson, . . .	1884	Town, ...	6,758	-	4,280,795

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Intro- duction.	Ownership.	With Water Supplies.	Without Water Supplies.	
Concord, . . .	1873	Town, ...	6,681	-	\$9,527,350
Great Barrington, .	1867	Great Barrington Fire District, .	6,627	-	10,392,283
	1888	Housatonic Water Works Com- pany (Housatonic).			
Needham, . . .	1890	Town, ...	6,542	-	9,010,865
Franklin, . . .	1884	Town, ...	6,440	-	5,065,217
Wellesley, . . .	1884	Town, ...	6,439	-	20,684,270
Fairhaven, . . .	1894	Fairhaven Water Company, .	6,277	-	4,501,594
Ipswich, ...	1894	Town, ...	6,272	-	5,719,240
Ludlow, ...	1873	Ludlow Manufacturing Company,	6,251	-	5,618,262
Grafton, ...	1886	Grafton Water Company, . .	6,250	-	3,825,768
Spencer, ...	1883	Town, ...	5,994	-	3,629,010
North Andover, .	1898	Town, ...	5,956	-	6,042,049
Westborough, . .	1879	Town, ...	5,925	-	3,342,715
Winchendon, . .	1896	Town, ...	5,908	-	4,447,007
Mansfield, . . .	1888	Mansfield Water Supply District,	5,772	-	4,523,040
Blackstone, . . .	1911	Woonsocket, R. I., Water Works,	5,689	-	2,465,488
Abington, ...	1887	Town, ...	5,646	-	3,763,381
Canton, ...	1889	Town, ...	5,623	-	6,838,814
Amherst, ...	1880	Amherst Water Company, . .	5,558	-	6,388,168
Lexington, ...	1884	Town, ...	5,538	-	10,028,177
Walpole, ...	1896	Town, ...	5,490	-	7,535,002
Orange, ...	1873	Town, ...	5,379	-	4,030,408
Dartmouth, . . .	1915	Town, ...	5,330	-	5,753,325
Millbury, ...	1895	Millbury Water Company, . .	5,295	-	3,399,117
Tewksbury, . . .	-	- - - -	-	5,265	1,861,780
Hingham, ...	1880	Hingham Water Company, . .	5,264	-	8,737,150
Chelmsford, ...	1907	North Chelmsford Fire District,	5,182	-	4,514,610
	1914	Chelmsford Water District, . .			
South Hadley, . . .	1872	South Hadley Fire District No. 1,	5,179	-	3,407,453
	1911	South Hadley Fire District No. 2,			
Wareham, ...	1894	Onset Water Company, . . .	5,176	-	6,680,145
	1908	Wareham Fire District, . . .			
Easton, ...	1887	North Easton Village District, .	5,064	-	7,285,854
	1915	South Easton and Eastondale Fire and Water District.			
Monson, ...	1895	Town, ...	5,004	-	1,978,410
Barnstable, . . .	1912	Barnstable Water Company, .	4,995	-	9,470,655
Uxbridge, ...	1879	Town, ...	4,921	-	4,360,270

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Introduction.	Ownership.	With Water Supplies.	Without Water Supplies.	
Randolph, . . .	1888	Town, ...	4,734	-	\$3,167,150
Agawam, . . .	1877	Town, ...	4,555	-	3,271,785
Lee, ...	1881	Berkshire Water Company, .	4,481	-	3,192,491
Dudley, ...	1910	Town, ...	4,373	-	2,501,264
Rockport, . . .	1895	Town, ...	4,351	-	4,085,090
Provincetown, .	1893	Town, ...	4,295	-	2,452,213
Warren, ...	-	- - - - -	-	4,268	2,666,885
Templeton, . . .	-	- - - - -	-	4,081	2,025,073
Dracut, ...	{ 1900 1906	{ American Woolen Company (Col- linsville). Dracut Water Supply District, .	4,022	-	2,589,538
Williamstown, .	1859	Williamstown Water Company, .	3,981	-	5,372,365
Falmouth, . . .	1899	Town, ...	3,917	-	16,991,255
Dalton, ...	1884	Dalton Fire District, ...	3,858	-	5,717,438
Foxborough, . .	{ 1891 1912	{ Foxborough Water Supply Dis- trict. East Foxborough Water Supply District.	3,755	-	2,816,130
East Bridgewater, .	1888	Town, ...	3,689	-	2,901,169
Medfield, . . .	1889	Medfield Water Company, . .	3,648	-	2,428,976
Hardwick, . . .	1887	George H. Gilbert Manufacturing Company.	3,596	-	3,135,484
Barre, ...	1895	Town, ...	3,476	-	2,832,245
Oxford, ...	1906	Oxford Water Company, . . .	3,476	-	2,108,931
Somerset, . . .	-	- - - - -	-	3,377	1,837,798
Leicester, . . .	{ 1891 1911	{ Leicester Water Supply District, Cherry Valley and Rochdale Water District.	3,322	-	2,514,107
Auburn, ...	-	- - - - -	-	3,281	1,786,575
Westport, . . .	-	- - - - -	-	3,262	2,456,575
Billerica, . . .	1898	Town, ...	3,246	-	5,507,928
Lenox, ...	1875	Lenox Water Company, . . .	3,242	-	8,477,062
Nantucket, . . .	1878	Wannacomet Water Company, .	3,166	-	4,674,185
Holbrook, . . .	1888	Town, ...	2,948	-	1,782,825
North Brookfield, .	1893	Town, ...	2,947	-	2,045,584
Manchester, . . .	1892	Town, ...	2,945	-	20,052,880
Medway, ...	1911	Town, ...	2,846	-	1,832,690
Westford, . . .	1908	Westford Water Company, . .	2,843	-	2,426,079
Pepperell, . . .	1909	Town, ...	2,839	-	2,355,442
Sutton, ...	-	- - - - -	-	2,829	1,549,929
Cohasset, . . .	1886	Cohasset Water Company, . .	2,800	-	9,875,915
Shrewsbury, . .	1915	Town, ...	2,794	-	2,978,363

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Intro- duction.	Ownership.	With Water Supplies.	Without Water Supplies.	
Holliston, . . .	1891	Holliston Water Company, . . .	2,788	-	\$2,147,329
Ayer, . . .	1887	Town, ...	2,779	-	2,439,172
Seekonk, . . .	-	- - -	-	2,767	1,875,780
West Bridgewater, .	1911	Town, ...	2,741	-	1,875,074
Deerfield, . . .	{ 1903 1911	{ South Deerfield Water Supply District. Deerfield Water Supply District,	{ 2,739	-	2,651,768
Bourne, . . .	-	- - -	-	2,672	7,409,125
Hadley, . . .	1905	Hadley Water Supply District, .	2,666	-	2,231,764
Hanover, . . .	-	- - -	-	2,666	2,287,980
Hopedale, . . .	1881	Milford Water Company, . . .	2,663	-	8,919,744
Scituate, . . .	1901	Scituate Water Company, . . .	2,661	-	5,938,950
Hatfield, . . .	1896	Town, ...	2,630	-	2,047,646
Norton, . . .	1912	Norton Water Company, . . .	2,587	-	1,676,800
Lancaster, . . .	1885	Town, ...	2,585	-	7,038,992
Kingston, . . .	1886	Town, ...	2,580	-	1,706,196
Swansea, . . .	-	- - -	-	2,558	1,951,853
Wilbraham, . . .	-	- - -	-	2,521	1,675,621
Holden, . . .	1905	Town, ...	2,514	-	1,910,232
Dighton, . . .	-	- - -	-	2,499	1,732,867
Hopkinton, . . .	1884	Town, ...	2,475	-	1,985,402
Sharon, . . .	1885	Town, ...	2,468	-	3,997,095
Wrentham, . . .	1908	Town, ...	2,414	-	1,605,450
Acushnet, . . .	-	- - -	-	2,387	1,217,710
Groveland, . . .	1915	Town, ...	2,377	-	1,386,298
Weston, . . .	1896	Weston Water Company, . . .	2,342	-	8,710,857
Groton, . . .	{ 1897 1912	{ Groton Water Company, . . . West Groton Water Supply Dis- trict.	{ 2,333	-	4,595,237
Wilmington, . . .	-	- - -	-	2,330	2,109,711
Hull, . . .	1882	Hingham Water Company, . . .	2,290	-	9,221,893
Shirley, . . .	1903	Shirley Village Water District, .	2,251	-	1,387,834
Rehoboth, . . .	-	- - -	-	2,228	1,070,243
Charlton, . . .	-	- - -	-	2,213	1,430,784
Douglas, . . .	1910	Town, ...	2,179	-	1,335,060
Harwich, . . .	-	- - -	-	2,179	1,817,658
Avon, . . .	1890	Town, ...	2,164	-	1,126,528
Acton, . . .	1912	West and South Water Supply District.	2,151	-	2,514,410
Williamsburg, . . .	1903	Town, ...	2,118	-	1,214,010

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Intro- duction.	Ownership.	With Water Supplies.	Without Water Supplies.	
Merrimac, . . .	1904	Town, ...	2,101	-	\$1,396,476
Belchertown, . . .	-	-	-	2,062	1,000,855
Ashburnham, . . .	1870	Town, ...	2,059	-	1,165,865
Brookfield, . . .	1889	Town, ...	2,059	-	1,538,107
Georgetown, . . .	-	-	-	2,058	1,377,270
Upton, ...	-	-	-	2,036	1,307,489
Wayland, ...	1878	Town, ...	2,033	-	3,018,196
Ashland, ...	1911	Town, ...	2,005	-	1,434,985
Bellingham, . . .	-	-	-	1,953	1,025,145
East Longmeadow,	1913	Town, ...	1,939	-	1,407,095
Duxbury, ...	1914	Duxbury Fire and Water District,	1,921	-	3,905,044
Stockbridge, . . .	1862	Stockbridge Water Company, .	1,901	-	4,517,515
Southborough, . .	-	-	-	1,898	2,364,784
Rutland, ...	1896	Town, ...	1,895	-	943,170
Hamilton, ...	-	-	-	1,879	6,692,140
Sheffield, ...	1897	Sheffield Water Company, . .	1,862	-	1,133,365
Colrain, ...	1902	Colrain Fire District No. 1, .	1,829	-	916,439
Dennis, ...	-	-	-	1,822	1,506,080
Townsend, ...	-	-	-	1,812	1,445,334
Raynham, ...	-	-	-	1,810	990,968
Northborough, . .	1882	Town, ...	1,797	-	1,988,242
Hanson, ...	-	-	-	1,796	1,545,500
Longmeadow, . . .	1895	Town, ...	1,782	-	3,616,360
Northfield, ...	1900	Northfield Water Company, .	1,782	-	1,510,986
Marshfield, ...	1890	Brant Rock Water Company, .	1,725	-	2,801,453
Salisbury, ...	1915	Salisbury Water Supply Com- pany.	1,717	-	1,709,445
Carver, ...	-	-	-	1,701	2,119,850
Sherborn, ...	-	-	-	1,696	2,397,878
Essex, ...	-	-	-	1,677	1,325,773
Chatham, ...	-	-	-	1,667	2,000,580
Freetown, ...	-	-	-	1,663	1,145,260
Sturbridge, ...	-	-	-	1,618	955,100
Lunenburg, ...	-	-	-	1,610	1,615,154
Westminster, . . .	-	-	-	1,594	1,002,925
Newbury, ...	-	-	-	1,590	1,669,018
Buckland, ...	-	-	-	1,569	2,041,021
Norwell, ...	-	-	-	1,563	1,384,674

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Intro- duction.	Ownership.	With Water Supplies.	Without Water Supplies.	
Cheshire, . . .	1876	Cheshire Water Company, . . .	1,535	-	\$888,289
West Newbury, . . .	-	- - -	-	1,529	1,115,974
Sandwich, . . .	-	- - -	-	1,500	1,525,350
Lakeville, . . .	-	- - -	-	1,491	1,284,540
Marion, . . .	1908	Town, ...	1,487	-	5,630,830
Shelburne, . . .	1912	Shelburne Falls Fire District, . .	1,484	-	1,961,266
Rowley, . . .	-	- - -	-	1,481	2,049,156
Westwood, . . .	-	- - -	-	1,448	4,511,538
Millis, . . .	1891	Town, ...	1,442	-	1,473,059
Huntington, . . .	1899	Huntington Fire District, . . .	1,427	-	774,305
Yarmouth, . . .	-	- - -	-	1,415	2,557,779
Plainville, . . .	1909	Town, ...	1,408	-	1,058,460
Sterling, . . .	-	- - -	-	1,403	1,370,079
Nahant, . . .	1885	Town, ...	1,387	-	8,439,491
Bedford, . . .	1909	Town, ...	1,365	-	1,988,789
Southwick, . . .	-	- - -	-	1,365	937,995
Mattapoisett, . . .	1913	Town, ...	1,352	-	2,346,428
Chester, . . .	1893	Chester Fire District, . . .	1,344	-	854,481
Pembroke, . . .	-	- - -	-	1,337	1,246,735
Tisbury, . . .	1887	Town, ...	1,324	-	2,158,536
West Boylston, . . .	-	- - -	-	1,318	1,029,610
Lincoln, . . .	1874	Town, ...	1,310	-	5,173,511
Middleton, . . .	1876	Town, ...	1,308	-	923,994
North Reading, . . .	-	- - -	-	1,292	993,306
West Brookfield, . . .	1913	Town, ...	1,288	-	1,051,401
Sunderland, . . .	1883	Sunderland Water Company, . .	1,278	-	725,267
West Stockbridge, . . .	1873	East Mountain Water Company, .	1,277	-	606,330
Edgartown, . . .	1906	Edgartown Water Company, . .	1,276	-	1,429,475
Norfolk, . . .	-	- - -	-	1,268	1,171,344
Hinsdale, . . .	1889	Hinsdale Fire District, . . .	1,257	-	784,943
Oak Bluffs, . . .	1890	Cottage City Water Company, . .	1,245	-	2,004,325
Littleton, . . .	1912	Town, ...	1,228	-	1,266,194
Conway, . . .	-	- - -	-	1,220	836,230
Sudbury, . . .	-	- - -	-	1,206	1,615,970
Topsfield, . . .	-	- - -	-	1,173	4,294,828
Erving, . . .	1896	Millers Falls Water Supply Dis- trict.	1,168	-	1,100,898
Orleans, . . .	-	- - -	-	1,166	4,830,613

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Intro- duction.	Ownership.	With Water Supplies.	Without Water Supplies.	
Rochester, . . .	-	- - - -	-	1,160	\$1,051,558
Stow, . . .	-	- - - -	-	1,127	1,476,537
Whately, . . .	-	- - - -	-	1,118	759,836
Clarksburg, . . .	-	- - - -	-	1,114	299,414
Lynnfield, . . .	-	- - - -	-	1,112	1,345,205
Harvard, . . .	-	- - - -	-	1,104	2,042,247
Russell, . . .	1911	Town, ...	1,104	-	1,784,891
Lanesborough, . . .	-	- - - -	-	1,089	781,737
Hubbardston, . . .	-	- - - -	-	1,084	793,775
Wenham, . . .	-	- - - -	-	1,068	3,662,150
New Marlborough, . . .	-	- - - -	-	1,030	894,885
Dover, . . .	-	- - - -	-	999	8,274,936
Ashfield, . . .	1904	Ashfield Water Company, . . .	994	-	913,101
Berkley, . . .	-	- - - -	-	985	571,277
Charlemont, . . .	-	- - - -	-	977	669,700
Becket, . . .	-	- - - -	-	973	691,305
Tyngsborough, . . .	-	- - - -	-	967	753,430
Gill, . . .	1888	Riverside Water Company, . . .	951	-	515,851
Southampton, . . .	-	- - - -	-	950	602,789
Wellfleet, . . .	-	- - - -	-	936	856,895
Brimfield, . . .	-	- - - -	-	934	657,691
Mendon, . . .	-	- - - -	-	933	742,305
Ashby, . . .	-	- - - -	-	922	790,021
Berlin, . . .	-	- - - -	-	865	670,330
Royalston, . . .	-	- - - -	-	802	747,654
Granby, . . .	-	- - - -	-	828	748,157
Enfield, . . .	-	- - - -	-	806	805,690
Princeton, . . .	-	- - - -	-	800	1,415,147
Bernardston, . . .	-	- - - -	-	790	594,783
Granville, . . .	1910	Granville Centre Water Company, . . .	784	-	541,634
Boylston, . . .	-	- - - -	-	783	570,825
Brewster, . . .	-	- - - -	-	783	883,995
Leverett, . . .	-	- - - -	-	779	383,144
Bolton, . . .	-	- - - -	-	768	782,831
Burlington, . . .	-	- - - -	-	751	973,437
Petersham, . . .	-	- - - -	-	727	1,040,642
Boxford, . . .	-	- - - -	-	714	1,353,713

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Intro- duction.	Ownership.	With Water Supplies.	Without Water Supplies.	
Dana, ...	-	-	-	712	\$468,883
Hampden, ...	-	-	-	670	486,065
Truro, ...	-	-	-	663	519,200
Cummington, ...	-	-	-	660	370,101
Halifax, ...	-	-	-	638	694,061
New Salem, ...	-	-	-	625	397,950
Blandford, ...	1909	Blandford Fire District, ...	623	-	692,964
Worthington, ...	1911	Worthington Fire District, ...	618	-	382,845
Egremont, ...	1913	South Egremont Water Company,	599	-	569,602
Plympton, ...	-	-	-	599	465,513
Richmond, ...	-	-	-	564	654,269
Sandisfield, ...	-	-	-	564	434,528
Chesterfield, ...	-	-	-	559	371,629
Eastham, ...	-	-	-	545	479,495
Oakham, ...	-	-	-	527	386,087
Savoy, ...	-	-	-	524	196,755
Hancock, ...	-	-	-	514	452,706
Pelham, ...	-	-	-	499	441,302
Carlisle, ...	-	-	-	490	660,527
Warwick, ...	-	-	-	477	455,270
Paxton, ...	-	-	-	471	421,493
New Braintree, ...	-	-	-	453	422,262
Otis, ...	-	-	-	442	299,764
West Tisbury, ...	-	-	-	441	663,559
Westhampton, ...	-	-	-	430	272,082
Florida, ...	-	-	-	427	583,117
Hawley, ...	-	-	-	427	245,158
Greenwich, ...	-	-	-	426	262,060
Rowe, ...	-	-	-	424	252,521
Phillipston, ...	-	-	-	390	305,668
Wendell, ...	-	-	-	388	549,332
Heath, ...	-	-	-	383	245,940
Plainfield, ...	-	-	-	375	195,573
Windsor, ...	-	-	-	375	294,192
Dunstable, ...	-	-	-	362	425,695
Monterey, ...	-	-	-	358	387,695
Leyden, ...	-	-	-	344	246,671

CITY OR TOWN.	PUBLIC WATER SUPPLY.		POPULATION IN 1915 OF CITIES AND TOWNS.		Valuation, 1915.
	Date of Intro- duction.	Ownership.	With Water Supplies.	Without Water Supplies.	
Wales, . . .	-	-	-	337	\$262,240
Tyringham, . .	-	-	-	327	353,277
Boxborough, . .	-	-	-	326	305,554
Middlefield, . .	-	-	-	325	217,883
Prescott, . . .	-	-	-	299	215,229
Monroe, . . .	-	-	-	296	251,403
Shutesbury, . .	-	-	-	292	382,861
Goshen, . . .	-	-	-	289	245,952
Chilmark, . . .	-	-	-	288	405,393
Washington, . .	-	-	-	275	306,271
Alford, . . .	-	-	-	271	206,318
Mashpee, . . .	-	-	-	263	358,760
Montgomery, . .	-	-	-	230	160,815
Tolland, . . .	-	-	-	199	263,173
Peru, . . .	-	-	-	195	174,047
Gay Head, . . .	-	-	-	175	45,090
Holland, . . .	-	-	-	159	123,760
Gosnold, . . .	-	-	-	155	809,570
Mount Washington,	-	-	-	95	145,821
New Ashford, . .	-	-	-	92	73,670

CONSUMPTION OF WATER.

Records of the consumption of water are kept in nearly all of the cities and towns where water is pumped, and in several places supplied by gravity Venturi meters have been installed to measure the quantity supplied.

The following table gives statistics with regard to the consumption of water in the year 1915 in those cities and towns from which records could be obtained. The daily consumption of water per inhabitant given in this table has been obtained by dividing the average daily consumption by the total population of the city or town as determined by the census of 1915. The quantity obtained in this manner is somewhat less than the actual consumption per person using the water because there are in all cities and towns a greater or less number of persons who do not use the public supply. This difference is most marked in some towns which contain villages to which the public water

supply has not been extended, and in towns where the works have been in operation but a short time and where water has not come into general use. In a few of the towns the population during the summer months is much greater than is shown by the census returns, and in such cases the consumption per inhabitant as given in the table is higher than it would be if allowance were made for the increased population in the summer. With a few exceptions, however, the difference between the census returns and the actual population supplied is not great.

Consumption of Water in Various Cities and Towns in 1915.

CITY OR TOWN.	Population.	AVERAGE DAILY CONSUMPTION.		CITY OR TOWN.	Population.	AVERAGE DAILY CONSUMPTION.	
		Gallons.	Gallons per Inhabitant.			Gallons.	Gallons per Inhabitant.
Metropolitan Water District: ¹ —	1,201,300	104,771,000	87	Attleboro, . . .	18,480	937,000	51
Arlington, . . .	14,889	825,000	55	Avon, . . .	2,164	79,000	37
Belmont, . . .	8,081	425,000	53	Ayer, . . .	2,779	173,000	62
Boston, . . .	745,439	77,652,000	104	Bedford, . . .	1,365	44,000	32
Chelsea, . . .	43,426	2,901,000	67	Beverly, . . .	22,959	1,605,000	70
Everett, . . .	37,718	2,599,000	69	Billerica, . . .	3,246	251,000	77
Lexington, . . .	5,538	359,000	65	Braintree, . . .	9,343	498,000	53
Malden, . . .	48,907	2,243,000	46	Brockton, . . .	62,288	2,479,000	40
Medford, . . .	30,509	1,245,000	41	Brookline, . . .	33,490	2,750,000	82
Melrose, . . .	16,880	852,000	50	Cambridge, . . .	108,822	8,957,000	82
Milton, . . .	8,600	339,000	39	Canton, . . .	5,623	313,000	56
Nahant, . . .	1,387	162,000	117	Chelmsford, . . .	5,182	88,000	17
Quincy, . . .	40,674	2,512,000	62	Clinton, . . .	13,192	637,000	48
Revere, . . .	25,178	1,485,000	59	Concord, . . .	6,681	457,000	68
Somerville, . . .	86,854	5,807,000	67	Danvers and Middleton, . . .	12,485	1,306,000	105
Stoneham, . . .	7,489	374,000	50	Dedham, . . .	11,043	973,000	88
Swampscott, . . .	7,345	436,000	59	Dudley, . . .	4,373	104,000	24
Watertown, . . .	16,515	1,025,000	62	Duxbury, . . .	1,921	48,000	25
Winthrop, . . .	12,758	700,000	55	East Bridgewater, . . .	3,689	83,000	23
Abington and Rockland, . . .	12,720	619,000	49	Easthampton, . . .	9,845	619,000	63
Acton, . . .	2,151	45,000	21	East Longmeadow, . . .	1,939	21,000	11
Agawam, . . .	4,555	108,000	24	Easton, . . .	5,064	137,000	27
Amesbury, . . .	8,543	454,000	53	Edgartown, . . .	1,276	66,000	52
Amherst, . . .	5,558	539,000	97	Fairhaven, . . .	6,277	333,000	53
Andover, . . .	7,978	655,000	82	Fall River, . . .	124,791	6,086,000	49
Ashland, . . .	2,005	29,000	14	Falmouth, . . .	3,917	418,000	107

¹ Including Newton, which is within the District, but supplied from independent works.

Consumption of Water in Various Cities and Towns in 1915 — Continued.

CITY OR TOWN.	Popu- lation.	AVERAGE DAILY CONSUMPTION.		CITY OR TOWN.	Popu- lation.	AVERAGE DAILY CONSUMPTION.	
		Gallons.	Gallons per Inhabi- tant.			Gallons.	Gallons per Inhabi- tant.
Fitchburg, . .	39,656	3,530,000	89	Montague and Erv- ing.	9,093	662,000	73
Foxborough, . .	3,755	194,000	52	Nantucket, . .	3,166	211,000	67
Framingham, . .	15,860	783,000	49	Natick, . . .	11,119	683,000	61
Franklin, . . .	6,440	357,000	55	Needham, . . .	6,542	405,000	62
Gardner, . . .	16,376	808,000	49	New Bedford, . .	109,568	7,647,000	70
Gloucester, . . .	24,478	1,313,000	54	Newburyport, . .	15,311	1,013,000	66
Grafton, . . .	6,250	126,000	20	Newton, . . .	43,113	2,830,000	66
Greenfield, . . .	12,618	1,171,000	93	North Andover, . .	5,956	295,000	50
Groton, . . .	2,333	115,000	49	North Attleborough,	9,398	349,000	37
Holliston, . . .	2,788	72,000	26	North Brookfield, .	2,947	222,000	75
Holyoke, . . .	60,816	6,211,000	102	Norton, . . .	2,587	92,000	36
Hudson, . . .	6,758	255,000	38	Norwood, . . .	10,977	991,000	90
Ipswich, . . .	6,272	341,000	54	Oak Bluffs, . . .	1,215	229,000	184
Lancaster, . . .	2,585	83,000	32	Orange, . . .	5,379	131,000	24
Lawrence, . . .	90,259	4,006,000	44	Peabody, . . .	18,625	2,629,000	141
Lincoln, . . .	1,310	202,000	154	Pepperell, . . .	2,839	105,000	37
Littleton, . . .	1,228	32,000	26	Pittsfield, . . .	39,607	5,630,000	142
Longmeadow, . .	1,782	83,000	47	Plainville, . . .	1,408	27,000	19
Lowell, . . .	107,978	5,427,000	50	Plymouth, . . .	12,926	1,300,000	101
Ludlow, . . .	6,251	157,000	25	Provincetown, . .	4,295	228,000	53
Lynn and Saugus,	106,029	6,385,000	60	Randolph and Hol- brook.	7,682	352,000	46
Manchester, . . .	2,945	400,000	136	Reading, . . .	6,805	224,000	33
Mansfield, . . .	5,772	446,000	77	Rockport, . . .	4,351	238,000	55
Marblehead, . . .	7,606	512,000	67	Salem, . . .	37,200	3,699,000	99
Marion, . . .	1,487	98,000	66	Sharon, . . .	2,468	115,000	47
Marlborough, . .	15,250	592,000	39	Shirley, . . .	2,251	74,000	33
Mattapoissett, .	1,352	41,000	30	Southbridge, . .	14,217	654,000	46
Maynard, . . .	6,770	230,000	34	Springfield, . . .	102,971	10,116,000	98
Medway, . . .	2,846	89,000	31	Stoughton, . . .	6,982	325,000	47
Merrimac, . . .	2,101	104,000	50	Taunton, . . .	36,161	2,222,000	61
Methuen, . . .	14,007	630,000	45	Tisbury, . . .	1,324	138,000	104
Middleborough, .	8,631	329,000	38	Wakefield, . . .	12,781	592,000	46
Milford and Hope- dale.	16,347	776,000	47	Walpole, . . .	5,490	632,000	115
Millbury, . . .	5,295	204,000	39	Waltham, . . .	30,154	2,294,000	76

Consumption of Water in Various Cities and Towns in 1915 — Concluded.

CITY OR TOWN.	Popu- lation.	AVERAGE DAILY CONSUMPTION.		CITY OR TOWN.	Popu- lation.	AVERAGE DAILY CONSUMPTION.	
		Gallons.	Gallons per Inhabi- tant.			Gallons.	Gallons per Inhabi- tant.
Ware, . . .	9,346	453,000	48	Weston, . . .	2,342	106,000	45
Wareham, . . .	5,176	148,000	29	Whitman, . . .	7,520	187,000	25
Webster, . . .	12,565	553,000	44	Winchendon, . . .	5,908	210,000	36
Wellesley, . . .	6,439	470,000	73	Winchester, . . .	10,005	556,000	56
West Bridgewater, . .	2,741	69,000	25	Woburn, . . .	16,410	1,996,000	122
West Brookfield, . .	1,288	45,000	35	Worcester, . . .	162,697	12,818,000	79
Westfield, . . .	18,411	1,844,000	100	Wrentham, . . .	2,414	104,000	43
Westford, . . .	2,843	94,000	33				

RAINFALL.

The normal yearly rainfall in Massachusetts as deduced from long-continued observations in various parts of the State is 44.62 inches. The average rainfall for the year 1915 in these places was 44.47 inches, a deficiency of 0.15 of an inch. The year was the twelfth in succession in which the rainfall has been less than the normal, the accumulated deficiency at the end of the year being 48.37 inches, or 3.75 inches more than the total rainfall in a normal year. There was an excess of precipitation in the months of January, February, July, August and December, and a deficiency in the other seven months of the year. The greatest excess in any month occurred in July, when the average rainfall was 8.15 inches, or 4.36 inches greater than the normal, and the greatest deficiency occurred in March, when the average rainfall was only 0.06 of an inch, or 3.84 inches less than the normal.

The following table gives the normal rainfall in the State for each month as deduced from observations at various places for a long period of years, together with the average rainfall at those places for each month during the year 1915 and the departure from the normal: —

MONTH.	Normal Rainfall (Inches).	Rainfall in 1915 (Inches).	Excess or Defi- ciency in 1915 (Inches).	MONTH.	Normal Rainfall (Inches).	Rainfall in 1915 (Inches).	Excess or Defi- ciency in 1915 (Inches).
January, .	3.77	6.77	+3.00	August, .	4.26	6.77	+2.51
February, .	3.60	4.32	+0.72	September, .	3.43	1.39	-2.04
March, .	3.90	0.06	-3.84	October, .	3.84	3.02	-0.82
April, .	3.59	2.34	-1.25	November, .	3.87	2.61	-1.26
May, .	3.67	1.76	-1.91	December, .	3.70	5.40	+1.70
June, .	3.20	1.88	-1.32				
July, .	3.79	8.15	+4.36	Total, .	44.62	44.47	-0.15

Although the average annual rainfall for the entire State during the year 1915 was but slightly less than the normal for a long period of years, its distribution was very unusual. In the month of January the average rainfall was very nearly twice the normal, being slightly more than the normal in the extreme northeasterly and northwesterly parts of the State but from two to three times the normal in the extreme southeasterly part of the State, where it amounted to 10.75 inches at New Bedford, 10.00 inches at Fall River, 9.93 inches at Taunton, 9.38 inches at Plymouth and 9.15 inches at Hyannis. With two or three exceptions the rainfall in the month of February was fairly uniform throughout the State and averaged but slightly more than the normal. In the month of March there was no appreciable precipitation at stations in the easterly and northeasterly sections of the State, but at most of the remaining stations some measurements were recorded, although at but few did the amount exceed .10 of an inch, the maximum being .41 of an inch recorded at Williamstown. An examination of the records available fails to show any previous year in which the average rainfall during the month of March was as low as in the year 1915. In the months of April, May and June the rainfall was less than the average for those months, and at the end of June the total accumulated deficiency for the first six months of the year amounted to 4.60 inches. Early in the morning of the first of July, however, the greatest fall of rain that has been recorded for many years occurred throughout the entire State, with the exception of the extreme southeasterly portion. On July 8 and 9 another storm occurred, which was general throughout the State and during which the rainfall was unusually heavy. During the remainder of the month the precipitation was frequent and of appreciable amounts, so that the total for the month was more than twice the average for a long period of years. In August the rainfall was also in excess of the normal, and at the end of that month there was an accumulated excess for the first eight months of the year of 2.27 inches. In September, October and November the rainfall was less than the normal for those months, while in December it was again in excess of the normal.

FLOW OF STREAMS.

Sudbury River.

The average flow of the Sudbury River during the year 1915 was 719,000 gallons per day per square mile, or 73 per cent. of the normal flow for the past forty-one years. The flow was in excess of the normal in the months of January, February, July and August, but less than the normal in the other eight months of the year. The greatest excess occurred in the month of August and the greatest deficiency in the month of March. The average flow for the driest six months, June to November, inclusive, was 480,000 gallons per day per square mile, or the greatest flow for such period since the year 1898.

In order to show the relation between the flow of the Sudbury River during each month of the year 1915 and the normal flow of that stream, as deduced from observations during forty-one years, from 1875 to 1915, inclusive, the following table has been prepared. The area of the watershed of the Sudbury River above the point of measurement is 75.2 square miles.

Table showing the Average Daily Flow of the Sudbury River for Each Month in the Year 1915, in Cubic Feet per Second per Square Mile of Drainage Area and in Million Gallons per Day per Square Mile of Drainage Area; also, Departure from the Normal Flow.

MONTH.	NORMAL FLOW.		ACTUAL FLOW IN 1915.		EXCESS OR DEFICIENCY	
	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.
January, ...	1.850	1.196	2.520	1.629	+0.670	+0.433
February, ...	2.605	1.684	2.893	1.870	+0.288	+0.186
March, ...	4.228	2.733	0.918	0.593	-3.310	-2.140
April, ...	3.057	1.976	0.912	0.590	-2.145	-1.386
May, ...	1.632	1.055	0.395	0.255	-1.237	-0.800
June, ...	0.723	0.467	0.156	0.101	-0.567	-0.366
July, ...	0.269	0.174	1.617	1.045	+1.348	+0.871
August, ...	0.383	0.248	1.808	1.168	+1.425	+0.920
September, ...	0.342	0.221	0.059	0.038	-0.283	-0.183
October, ...	0.651	0.421	0.357	0.231	-0.294	-0.190
November, ...	1.160	0.750	0.404	0.261	-0.756	-0.489
December, ...	1.507	0.974	1.390	0.898	-0.117	-0.076
Average for whole year,	1.528	0.988	1.113	0.719	-0.415	-0.269

The following table gives the rainfall upon the Sudbury River watershed and the total yield expressed in inches in depth upon the watershed (inches of rainfall collected) for each of the past forty-one years, from 1875 to 1915, inclusive, together with the average for the entire period of forty-one years:—

Rainfall, in Inches, received and collected on the Sudbury River Watershed.

MONTH.	1875.			1876.			1877.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	2.42	0.184	7.6	1.83	1.147	62.7	3.22	1.174	36.5
February, ...	3.15	2.411	76.5	4.21	2.282	54.2	0.74	1.529	206.9
March, ...	3.74	2.862	76.5	7.43	7.911	106.5	8.36	8.586	102.7
April, ...	3.23	5.263	162.9	4.20	5.683	135.4	3.43	4.132	120.3
May, ...	3.56	2.119	59.5	2.76	2.031	73.5	3.70	2.482	67.0
June, ...	6.24	1.501	24.0	2.04	0.383	18.8	2.43	1.031	42.5
July, ...	3.57	0.573	16.0	9.13	0.326	3.6	2.95	0.360	12.2
August, ...	5.53	0.706	12.8	1.72	0.723	42.0	3.68	0.216	5.9
September, ...	3.43	0.358	10.4	4.62	0.318	6.9	0.32	0.103	31.9
October, ...	4.85	1.152	23.8	2.24	0.417	18.6	8.52	1.127	13.2
November, ...	4.83	2.248	46.5	5.76	1.878	32.6	5.80	2.447	42.2
December, ...	0.94	1.041	110.7	3.62	0.809	22.3	0.87	2.300	264.4
Totals and averages, .	45.49	20.418	44.9	49.56	23.908	48.2	44.02	25.487	57.9

MONTH.	1878.			1879.			1880.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	5.63	3.228	57.3	2.48	1.249	50.4	3.57	2.000	56.0
February, ...	5.97	3.972	66.5	3.56	2.756	77.4	3.98	2.982	74.9
March, ...	4.69	6.256	133.4	5.14	4.156	80.9	3.31	2.451	73.9
April, ...	5.79	2.807	48.5	4.72	5.379	114.1	3.11	2.017	65.0
May, ...	0.96	2.487	260.2	1.58	1.987	125.8	1.84	0.917	50.0
June, ...	3.88	0.873	22.5	3.79	0.713	18.8	2.14	0.303	14.2
July, ...	2.97	0.229	7.7	3.93	0.281	7.1	6.27	0.315	5.0
August, ...	6.94	0.848	12.2	6.51	0.705	10.8	4.01	0.212	5.3
September, ...	1.29	0.277	21.5	1.88	0.243	12.9	1.60	0.138	8.6
October, ...	6.42	0.921	14.3	0.81	0.126	15.6	3.74	0.181	4.8
November, ...	7.02	2.922	41.6	2.68	0.355	13.2	1.78	0.354	19.9
December, ...	6.37	5.667	89.0	4.34	0.825	19.0	2.83	0.312	11.0
Totals and averages, .	57.93	30.487	52.6	41.42	18.775	45.3	38.18	12.182	31.9

Rainfall, in Inches, received and collected, etc. — Continued.

MONTH.	1881.			1882.			1883.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	5.56	0.740	13.3	5.95	2.213	37.2	2.81	0.597	21.2
February, ...	4.65	2.491	53.6	4.55	3.872	85.2	3.87	1.664	43.0
March, ...	5.73	7.142	124.6	2.65	5.064	191.2	1.78	2.873	161.4
April, ...	2.00	2.669	133.4	1.82	1.497	82.1	1.84	2.330	126.3
May, ...	3.51	1.721	49.0	5.07	2.304	45.5	4.19	1.673	40.0
June, ...	5.39	2.309	42.8	1.66	0.913	54.9	2.40	0.518	21.6
July, ...	2.35	0.493	21.0	1.77	0.154	8.7	2.68	0.206	7.7
August, ...	1.36	0.264	19.4	1.67	0.099	5.9	0.73	0.140	19.1
September, ...	2.62	0.340	13.0	8.74	0.529	6.0	1.52	0.157	10.4
October, ...	2.95	0.331	11.2	2.07	0.534	25.7	5.60	0.331	5.9
November, ...	4.09	0.682	16.7	1.15	0.362	31.5	1.81	0.354	19.5
December, ...	3.96	1.383	34.9	2.30	0.561	24.5	3.55	0.345	9.7
Totals and averages, .	44.17	20.565	46.6	39.40	18.102	45.9	32.78	11.188	34.1

MONTH.	1884.			1885.			1886.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	5.09	1.775	34.9	4.71	2.203	46.8	6.36	2.606	40.9
February, ...	6.54	4.742	72.5	3.87	2.182	56.4	6.28	7.734	123.2
March, ...	4.72	6.752	143.1	1.07	2.805	262.1	3.61	3.672	101.7
April, ...	4.41	4.925	111.8	3.60	3.133	86.9	2.22	3.361	151.1
May, ...	3.47	1.838	53.0	3.48	2.383	68.4	3.00	1.285	42.9
June, ...	3.44	0.719	20.9	2.87	0.735	25.7	1.47	0.350	23.9
July, ...	3.67	0.399	10.9	1.43	0.111	7.8	3.27	0.206	6.3
August, ...	4.65	0.458	9.8	7.18	0.429	6.0	4.10	0.168	4.1
September, ...	0.5	0.076	8.9	1.43	0.209	14.7	2.90	0.203	7.0
October, ...	2.48	0.148	6.0	5.09	0.599	11.8	3.24	0.260	8.0
November, ...	2.65	0.302	11.4	6.09	2.033	33.3	4.64	1.161	25.0
December, ...	5.17	1.650	31.9	2.72	2.094	77.0	4.97	1.819	36.6
Totals and averages, .	47.14	23.784	50.5	43.54	18.916	43.4	46.06	22.825	49.5

Rainfall, in Inches, received and collected, etc. — Continued.

MONTH.	1887.			1888.			1889.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	5.20	4.619	88.8	4.15	1.878	45.3	5.37	4.963	92.4
February, ...	4.78	4.558	95.3	3.68	3.255	88.3	1.65	1.926	116.4
March, ...	4.90	5.116	104.4	6.02	5.775	95.9	2.37	2.388	100.9
April, ...	4.27	4.522	106.0	2.43	4.566	188.3	3.41	2.434	71.4
May, ...	1.16	1.799	154.5	4.82	2.912	60.3	2.95	1.569	53.3
June, ...	2.65	0.714	26.9	2.54	0.728	28.7	2.80	1.128	40.3
July, ...	3.76	0.204	5.5	1.41	0.209	14.9	8.94	1.130	12.6
August, ...	0.28	0.382	7.2	6.22	0.677	10.9	4.18	2.554	61.2
September, ...	1.32	0.191	14.5	8.59	1.994	23.2	4.60	1.422	30.9
October, ...	2.83	0.339	12.0	4.99	3.566	71.4	4.25	2.194	51.6
November, ...	2.67	0.636	23.8	7.22	4.761	65.9	6.29	3.351	53.3
December, ...	3.88	1.147	29.6	5.40	5.428	100.6	3.14	3.997	127.3
Totals and averages, .	42.70	24.227	56.7	57.47	35.749	62.2	49.95	29.056	58.2

MONTH.	1890.			1891.			1892.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	2.53	2.237	88.4	7.02	5.383	76.7	5.85	3.335	57.0
February, ...	3.51	2.463	70.3	5.23	5.616	107.3	3.14	1.574	50.1
March, ...	7.73	6.498	84.0	6.48	7.944	122.7	4.06	3.488	85.9
April, ...	2.64	3.236	122.3	3.91	4.138	106.0	0.83	1.504	181.1
May, ...	5.21	2.437	46.8	2.01	1.039	51.7	5.58	2.245	40.2
June, ...	2.08	0.980	48.3	3.77	0.714	18.9	2.76	0.739	26.8
July, ...	2.46	0.191	7.8	3.39	0.266	7.8	4.23	0.382	9.0
August, ...	3.87	0.235	6.1	4.73	0.290	6.1	4.44	0.500	11.3
September, ...	6.00	0.790	13.2	2.38	0.350	14.7	2.84	0.396	13.9
October, ...	10.51	4.053	38.6	3.83	0.375	9.8	1.17	0.224	19.2
November, ...	1.20	2.097	174.7	3.09	0.526	17.0	5.80	1.204	20.7
December, ...	5.31	1.776	33.5	3.68	0.971	26.3	1.13	0.865	76.9
Totals and averages, .	53.00	26.993	50.9	49.52	27.612	55.8	41.83	16.456	39.3

Rainfall, in Inches, received and collected, etc. — Continued.

MONTH.	1893.			1894.			1895.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	2.92	0.773	26.4	4.09	1.236	30.2	4.06	1.844	45.4
February, ...	8.20	2.485	30.3	3.91	1.596	40.8	1.39	0.871	62.5
March, ...	3.67	5.789	157.7	1.43	3.992	278.2	2.98	4.299	144.2
April, ...	3.60	3.668	101.7	3.42	2.832	82.9	5.25	4.341	82.7
May, ...	6.61	5.143	77.8	4.24	1.498	35.4	2.02	1.134	56.1
June, ...	2.38	0.759	31.9	1.15	0.723	62.6	2.77	0.301	10.8
July, ...	2.57	0.282	11.0	3.26	0.287	8.8	5.04	0.411	8.2
August, ...	5.41	0.322	5.9	2.03	0.373	18.4	4.15	0.409	9.9
September, ...	1.74	0.187	10.8	2.63	0.258	9.8	2.30	0.153	6.7
October, ...	4.07	0.395	9.7	5.34	0.668	12.5	10.68	2.460	23.0
November, ...	2.20	0.550	25.1	3.43	1.442	42.1	6.63	4.794	72.4
December, ...	4.86	1.421	29.2	4.81	1.277	26.5	3.35	3.179	94.9
Totals and averages, .	48.23	21.774	45.2	39.74	16.182	40.7	50.62	24.196	47.8

MONTH.	1896.			1897.			1898.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	2.39	1.933	80.9	4.00	1.507	37.6	6.83	2.922	42.8
February, ...	7.18	4.466	62.2	2.91	1.718	59.0	4.49	4.869	108.5
March, ...	5.24	6.841	130.7	3.66	4.575	125.0	2.40	4.645	193.5
April, ...	1.57	2.579	164.3	2.82	2.615	92.7	4.66	3.158	67.8
May, ...	2.57	0.641	24.9	4.37	1.632	37.3	3.22	2.222	68.9
June, ...	3.22	0.689	21.4	4.46	1.661	37.3	2.48	0.915	36.9
July, ...	2.51	0.170	6.8	5.44	1.174	21.6	4.09	0.411	10.1
August, ...	2.40	0.102	4.3	3.51	1.053	30.0	8.17	1.974	24.2
September, ...	7.72	0.669	8.7	2.94	0.315	10.7	2.62	0.637	24.4
October, ...	3.76	1.055	28.0	0.47	0.168	35.7	6.71	2.069	30.8
November, ...	3.02	1.137	37.7	6.40	1.570	24.5	6.93	3.429	49.5
December, ...	2.12	1.171	55.1	5.21	2.827	54.3	3.28	3.208	97.7
Totals and averages, .	43.70	21.453	49.1	46.19	20.815	45.1	55.88	30.459	54.5

Rainfall, in Inches, received and collected, etc. — Continued.

MONTH.	1899.			1900.			1901.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	4.18	4.082	97.7	4.96	1.417	28.6	1.82	0.779	42.7
February, ...	4.91	2.225	45.3	9.14	6.123	67.0	1.52	0.483	31.7
March, ...	7.01	7.501	107.0	6.35	6.518	102.6	6.57	4.912	74.8
April, ...	1.90	4.351	229.0	2.58	2.330	90.2	8.60	7.257	84.4
May, ...	1.45	0.911	62.8	4.32	2.341	54.2	7.23	5.269	72.9
June, ...	2.51	0.114	4.6	2.99	0.545	18.3	1.38	1.299	94.1
July, ...	3.22	0.035	1.1	2.42	-0.032	-1.3	5.71	0.545	9.6
August, ...	1.43	-0.063	-4.4	2.26	-0.060	-2.7	4.57	0.756	16.5
September, ...	3.95	0.162	4.1	3.36	0.112	3.3	3.30	0.527	15.9
October, ...	2.69	0.206	7.7	3.83	0.331	8.6	2.82	0.734	26.0
November, ...	2.18	0.525	24.1	5.70	1.144	20.1	2.90	0.819	28.3
December, ...	1.78	0.392	22.0	2.74	1.955	71.4	9.69	4.808	49.6
Totals and averages, .	37.21	20.441	54.9	50.65	22.724	44.9	56.11	28.188	50.2

MONTH.	1902.			1903.			1904.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	2.52	3.145	125.1	3.80	3.096	81.4	4.87	0.851	17.5
February, ...	6.18	2.697	43.6	3.95	3.672	93.0	3.00	1.472	49.1
March, ...	5.34	7.491	140.3	6.63	6.161	92.9	2.72	5.349	196.8
April, ...	4.13	3.254	78.8	2.99	3.903	130.5	8.87	5.685	64.1
May, ...	1.86	1.325	71.3	0.93	0.625	67.4	2.65	3.112	117.7
June, ...	2.89	0.523	18.1	9.25	3.431	37.1	2.80	0.723	25.8
July, ...	2.94	0.117	4.0	2.77	0.794	28.7	1.96	0.111	5.7
August, ...	3.40	0.240	7.1	3.67	0.547	14.9	3.86	0.303	7.8
September, ...	4.54	0.308	6.8	1.75	0.225	12.8	5.80	0.685	11.8
October, ...	4.44	0.902	20.3	4.72	0.877	18.6	1.64	0.348	21.2
November, ...	1.45	0.767	52.7	1.56	0.626	40.2	1.73	0.499	28.8
December, ...	6.38	3.173	49.8	3.14	1.038	33.1	2.92	0.481	16.5
Totals and averages, .	46.07	23.942	52.0	45.16	24.995	55.3	42.82	19.619	45.8

Rainfall, in Inches, received and collected, etc. — Continued.

MONTH.	1905.			1906.			1907.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	5.26	2.516	47.8	2.47	2.012	81.5	3.28	2.411	73.4
February, ...	2.20	0.531	24.2	2.92	1.676	57.4	2.17	1.005	46.2
March, ...	3.15	4.456	141.6	6.32	4.297	68.0	1.91	2.958	154.6
April, ...	2.72	2.837	104.3	2.88	3.364	116.6	3.41	2.774	81.5
May, ...	1.31	0.530	40.3	5.66	1.890	33.4	3.63	1.584	43.6
June, ...	5.00	0.806	16.1	3.91	1.220	31.2	3.53	1.314	37.2
July, ...	5.47	0.316	5.8	3.42	0.709	20.7	1.86	0.015	0.8
August, ...	2.70	0.204	7.6	3.02	0.321	10.6	1.07	—0.186	—17.4
September, ...	6.88	2.152	31.3	3.30	0.034	1.0	8.76	0.934	10.7
October, ...	1.54	0.282	18.3	3.40	0.538	15.8	4.17	1.321	31.7
November, ...	2.07	0.481	23.3	2.69	0.834	31.1	6.12	3.450	56.4
December, ...	4.01	1.583	39.5	4.49	1.175	26.2	4.47	3.624	81.1
Totals and averages, .	42.31	16.694	39.5	44.48	18.070	40.6	44.38	21.204	47.8

MONTH.	1908.			1909.			1910.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	3.60	3.434	95.4	3.98	0.700	17.6	5.39	2.657	49.2
February, ...	4.56	2.564	56.3	5.80	3.634	63.6	5.06	2.979	58.9
March, ...	3.82	4.026	105.5	4.26	3.093	72.7	0.85	3.486	408.7
April, ...	1.88	1.929	102.6	4.67	2.970	63.6	2.75	1.151	41.9
May, ...	5.51	1.865	33.9	2.42	1.791	73.9	1.29	0.495	38.4
June, ...	0.86	0.335	38.9	2.81	0.413	14.7	4.68	0.891	19.0
July, ...	3.71	—0.025	—0.7	1.59	—0.216	—13.5	2.03	—0.182	—9.0
August, ...	4.57	0.181	4.0	2.93	—0.080	—2.7	2.62	—0.130	—5.0
September, ...	0.97	—0.141	—14.5	4.74	0.257	5.4	2.49	0.008	0.3
October, ...	2.55	0.083	3.3	1.12	—0.091	—8.1	1.86	—0.091	—4.9
November, ...	0.98	0.122	12.5	3.38	0.142	4.2	4.13	0.304	7.4
December, ...	3.14	0.243	7.7	4.05	0.469	11.6	2.49	0.395	15.8
Totals and averages, .	36.15	14.616	40.4	41.75	13.132	31.5	35.64	11.963	33.6

Rainfall, in Inches, received and collected, etc. — Concluded.

MONTH.	1911.			1912.			1913.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	2.88	0.925	32.1	2.94	1.299	44.1	3.17	1.857	58.5
February, ...	2.77	1.128	40.7	2.77	1.998	72.2	2.82	1.215	43.1
March, ...	3.59	2.042	56.9	6.46	5.515	85.3	5.75	3.727	64.8
April, ...	2.81	2.461	87.4	4.37	3.859	88.3	4.25	3.852	90.6
May, ...	1.01	0.567	56.1	4.55	2.580	56.7	3.97	1.547	39.0
June, ...	2.53	0.367	14.6	0.46	0.255	56.1	1.98	0.257	13.0
July, ...	3.19	-0.025	-0.8	3.24	-0.137	-4.2	3.60	-0.111	-3.1
August, ...	4.94	0.036	0.7	3.05	-0.053	-1.7	3.64	-0.095	-2.6
September, ...	2.75	0.131	4.8	1.76	-0.049	-2.8	3.77	0.152	4.0
October, ...	3.69	0.528	14.3	2.35	-0.024	-1.0	5.53	0.863	15.6
November, ...	4.62	1.024	22.2	3.64	0.285	7.8	2.65	0.828	31.3
December, ...	3.60	1.620	44.9	5.13	0.882	17.2	3.18	1.305	41.1
Totals and averages, .	38.38	10.804	28.2	40.72	16.410	40.3	44.31	15.397	34.8

MONTH.	1914.			1915.			MEAN FOR FORTY-ONE YEARS, 1875-1915.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	3.85	1.619	42.1	6.51	2.906	44.7	4.14	2.133	51.6
February, ...	4.07	1.625	39.9	3.58	3.013	84.1	4.12	2.734	66.4
March, ...	4.57	5.404	118.0	0.05	1.058	2,227.4	4.36	4.875	112.0
April, ...	5.10	4.061	79.6	2.48	1.018	41.0	3.55	3.411	96.1
May, ...	3.08	2.765	89.7	1.74	0.455	26.1	3.28	1.882	57.4
June, ...	1.90	0.008	0.4	3.65	0.174	4.8	3.02	0.807	26.7
July, ...	3.44	0.190	5.5	8.12	1.865	23.0	3.65	0.311	8.5
August, ...	3.82	0.277	7.3	5.87	2.084	35.5	3.90	0.442	11.3
September, ...	0.29	-0.234	-79.8	1.10	0.066	6.1	3.33	0.381	11.5
October, ...	1.60	-0.105	-6.6	2.95	0.412	14.0	3.84	0.751	19.6
November, ...	2.53	0.168	6.7	2.79	0.451	16.2	3.76	1.294	34.4
December, ...	3.46	0.446	12.9	5.09	1.602	31.5	3.84	1.738	45.2
Totals and averages, .	37.71	16.224	43.0	43.93	15.104	34.3	44.79	20.759	46.4

The following table gives the record of the yield of the Sudbury River watershed for each of the past forty-one years, the flow being expressed in gallons per day per square mile of watershed in order to render the table more convenient for use in estimating the probable yield of watersheds used as sources of water supply:—

Yield of the Sudbury River Watershed in Gallons per Day per Square Mile.¹

MONTH.	1875.	1876.	1877.	1878.	1879.	1880.
January, ...	103,000	643,000	658,000	1,810,000	700,000	1,121,000
February, ...	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000
March, ...	1,604,000	4,435,000	4,813,000	3,507,900	2,330,000	1,374,000
April, ...	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,168,000
May, ...	1,188,000	1,139,000	1,391,000	1,394,000	1,114,000	514,000
June, ...	870,000	222,000	597,000	506,000	413,000	176,000
July, ...	321,000	183,000	202,000	128,000	158,000	177,000
August, ...	396,000	405,000	121,000	475,000	395,000	119,000
September, ...	207,000	184,000	60,000	160,000	141,000	80,000
October, ...	646,000	234,000	632,000	516,000	71,000	101,000
November, ...	1,302,000	1,088,000	1,418,000	1,693,000	206,000	205,000
December, ...	584,000	454,000	1,289,000	3,177,000	462,000	175,000
Average for whole year, ...	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000
Average for driest six months, ...	574,000	384,000	502,000	532,000	230,000	143,000

MONTH.	1881.	1882.	1883.	1884.	1885.	1886.
January, ...	415,000	1,241,000	335,000	995,000	1,235,000	1,461,000
February, ...	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000	4,800,000
March, ...	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000	2,059,000
April, ...	1,546,000	867,000	1,350,000	2,853,000	1,815,000	1,947,000
May, ...	965,000	1,292,000	938,000	1,030,000	1,336,000	720,000
June, ...	1,338,000	529,000	300,000	417,000	426,000	203,000
July, ...	276,000	86,000	115,000	224,000	62,000	115,000
August, ...	148,000	55,000	78,000	257,000	240,000	94,000
September, ...	197,000	306,000	91,000	44,000	121,000	118,000
October, ...	186,000	299,000	186,000	83,000	336,000	146,000
November, ...	395,000	210,000	205,000	175,000	1,178,000	673,000
December, ...	775,000	314,000	193,000	925,000	1,174,000	1,020,000
Average for whole year, ...	979,000	862,000	533,000	1,129,000	901,000	1,087,000
Average for driest six months, ...	330,000	211,000	145,000	200,000	391,000	223,000

¹ The area of the Sudbury River watershed used in making up these records included water surfaces amounting to about 2 per cent. of the whole area, from 1875 to 1878 inclusive, subsequently increasing by the construction of storage reservoirs to about 3 per cent. in 1879, to 3.5 per cent. in 1885, to 4 per cent. in 1894 and to 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

Yield of the Sudbury River Watershed in Gallons per Day per Square Mile —
Continued.

MONTH.	1887.	1888.	1889.	1890.	1891.	1892.
January, ...	2,589,000	1,053,000	2,782,000	1,254,000	3,018,000	1,870,000
February, ...	2,829,000	1,951,000	1,195,000	1,529,000	3,486,000	943,000
March, ...	2,868,000	3,237,000	1,339,000	3,643,000	4,453,000	1,955,000
April, ...	2,620,000	2,645,000	1,410,000	1,875,000	2,397,000	871,000
May, ...	1,009,000	1,632,000	880,000	1,366,000	582,000	1,259,000
June, ...	414,000	422,000	653,000	568,000	414,000	428,000
July, ...	114,000	117,000	633,000	108,000	149,000	214,000
August, ...	214,000	380,000	1,432,000	132,000	163,000	280,000
September, ...	111,000	1,155,000	824,000	458,000	203,000	229,000
October, ...	190,000	1,999,000	1,230,000	2,272,000	210,000	126,000
November, ...	368,000	2,758,000	1,941,000	1,215,000	305,000	697,000
December, ...	643,000	3,043,000	2,241,000	997,000	544,000	485,000
Average for whole year, ...	1,154,000	1,697,000	1,383,000	1,285,000	1,315,000	781,000
Average for driest six months, ...	234,000	953,000	944,000	747,000	239,000	327,000

MONTH.	1893.	1894.	1895.	1896.	1897.	1898.
January, ...	433,000	693,000	1,034,000	1,084,000	845,000	1,638,000
February, ...	1,542,000	991,000	541,000	2,676,000	1,067,000	3,022,000
March, ...	3,245,000	2,238,000	2,410,000	3,835,000	2,565,000	2,604,000
April, ...	2,125,000	1,640,000	2,515,000	1,494,000	1,515,000	1,829,000
May, ...	2,883,000	840,000	636,000	360,000	915,000	1,246,000
June, ...	440,000	419,000	174,000	399,000	962,000	530,000
July, ...	158,000	161,000	231,000	95,000	658,000	231,000
August, ...	181,000	209,000	229,000	57,000	591,000	1,107,000
September, ...	108,000	150,000	89,000	388,000	182,000	369,000
October, ...	221,000	374,000	1,379,000	592,000	94,000	1,160,000
November, ...	319,000	836,000	2,777,000	659,000	909,000	1,986,000
December, ...	797,000	716,000	1,782,000	657,000	1,584,000	1,799,000
Average for whole year, ...	1,037,000	770,000	1,152,000	1,019,000	991,000	1,450,000
Average for driest six months, ...	237,000	356,000	460,000	314,000	564,000	777,000

Yield of the Sudbury River Watershed in Gallons per Day per Square Mile—
Continued.

MONTH.	1899.	1900.	1901.	1902.	1903.	1904.
January, ...	2,288,000	794,000	437,000	1,763,000	1,736,000	477,000
February, ...	1,381,000	3,800,000	300,000	1,674,000	2,279,000	882,000
March, ...	4,205,000	3,654,000	2,755,000	4,199,000	3,454,000	2,999,000
April, ...	2,521,000	1,350,000	4,204,000	1,885,000	2,261,000	3,294,000
May, ...	511,000	1,312,000	2,954,000	743,000	351,000	1,745,000
June, ...	66,000	316,000	753,000	303,000	1,987,000	419,000
July, ...	19,000	—18,000	306,000	66,000	445,000	62,000
August, ...	—35,000	—34,000	424,000	135,000	307,000	170,000
September, ...	94,000	65,000	305,000	178,000	130,000	397,000
October, ...	115,000	186,000	412,000	506,000	492,000	191,000
November, ...	304,000	663,000	474,000	444,000	363,000	289,000
December, ...	220,000	1,096,000	2,695,000	1,779,000	582,000	269,000
Average for whole year, ...	973,000	1,082,000	1,342,000	1,140,000	1,190,000	931,000
Average for driest six months, ...	93,000	194,000	445,000	271,000	388,000	228,000

MONTH.	1905.	1906.	1907.	1908.	1909.	1910.
January, ...	1,410,000	1,128,000	1,351,000	1,925,000	392,000	1,490,000
February, ...	330,000	1,041,000	624,000	1,536,000	2,286,000	1,849,000
March, ...	2,497,000	2,409,000	1,658,000	2,257,000	1,734,000	1,954,000
April, ...	1,643,000	1,949,000	1,607,000	1,117,000	1,721,000	667,000
May, ...	297,000	1,059,000	888,000	1,046,000	1,004,000	277,000
June, ...	467,000	707,000	761,000	194,000	239,000	516,000
July, ...	177,000	398,000	9,000	—14,000	—121,000	—102,000
August, ...	114,000	180,000	—104,000	102,000	—45,000	—73,000
September, ...	1,246,000	19,000	541,000	—82,000	149,000	5,000
October, ...	158,000	301,000	741,000	47,000	—51,000	—51,000
November, ...	279,000	483,000	1,998,000	71,000	82,000	176,000
December, ...	887,000	659,000	2,032,000	136,000	263,000	221,000
Average for whole year, ...	795,000	860,000	1,010,000	694,000	625,000	570,000
Average for driest six months, ...	403,000	341,000	471,000	44,000	40,000	29,000

Yield of the Sudbury River Watershed in Gallons per Day per Square Mile —
Concluded.

MONTH.	1911.	1912.	1913.	1914.	1915.	Mean for Forty-one Years, 1875-1915.
January, ...	519,000	728,000	1,041,000	908,000	1,629,000	1,196,000
February, ...	700,000	1,197,000	754,000	1,009,000	1,870,000	1,684,000
March, ...	1,144,000	3,092,000	2,090,000	3,029,000	593,000	2,733,000
April, ...	1,426,000	2,235,000	2,232,000	2,353,000	590,000	1,976,000
May, ...	318,000	1,447,000	867,000	1,550,000	255,000	1,055,000
June, ...	213,000	148,000	149,000	5,000	101,000	467,000
July, ...	-14,000	-77,000	-62,000	107,000	1,045,000	174,000
August, ...	20,000	-29,000	-54,000	156,000	1,168,000	248,000
September, ...	76,000	-28,000	88,000	-135,000	38,000	221,000
October, ...	296,000	-14,000	484,000	-59,000	231,000	421,000
November, ...	593,000	165,000	480,000	97,000	261,000	750,000
December, ...	908,000	494,000	732,000	250,000	898,000	974,000
Average for whole year, ...	514,000	779,000	733,000	772,000	719,000	988,000
Average for driest six months, ...	152,000	26,000	180,000	29,000	480,000	379,000

NOTE. — The recorded yields, subsequent to the year 1897, are less accurate than those for previous years, particularly during months of small yield, due to unavoidable inaccuracies in the measurement of large quantities of water received from the Wachusett Reservoir.

Nashua River.

The average flow of the South Branch of the Nashua River above Clinton during the year 1915 was 942,000 gallons per day per square mile, or 88 per cent. of the normal flow for the past nineteen years. The flow was in excess of the normal in the months of January, February, July, August and December but less than the normal in the other seven months of the year. The greatest excess occurred in the month of August and the greatest deficiency in the month of March. The average flow for the driest six months, May to October, inclusive, was 666,000 gallons per day per square mile, the greatest flow for such a period since the year 1907.

In order to show the relation between the flow of the Nashua River during each month of the year 1915 and the normal flow of that stream as deduced from observations during nineteen years, from 1897 to 1915, inclusive, the following table has been prepared. The area of the watershed of the Nashua River above the point of measurement was 119 square miles from 1897 to 1907 and 118.19 square miles

from 1908 to 1913, inclusive. Since Jan. 1, 1914, the city of Worcester has been diverting water from 9.35 square miles of this watershed for the supply of that city, leaving the net watershed area 108.84 square miles. In the calculations of yield allowance has been made for water overflowing from the Worcester area.

Table showing the Average Daily Flow of the South Branch of the Nashua River for Each Month in the Year 1915, in Cubic Feet per Second per Square Mile of Drainage Area and in Million Gallons per Day per Square Mile of Drainage Area; also, Departure from the Normal Flow.

MONTH.	NORMAL FLOW.		ACTUAL FLOW IN 1915.		EXCESS OR DEFICIENCY.	
	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.
January, ...	1.907	1.233	3.190	2.062	+1.283	+0.829
February, ...	2.148	1.388	3.034	1.961	+0.886	+0.573
March, ...	4.002	2.587	0.885	0.572	-3.117	-2.015
April, ...	3.269	2.113	1.433	0.926	-1.836	-1.187
May, ...	1.812	1.171	0.704	0.455	-1.108	-0.716
June, ...	1.083	0.700	0.353	0.228	-0.730	-0.472
July, ...	0.635	0.411	1.676	1.083	+1.041	+0.672
August, ...	0.684	0.442	2.564	1.657	+1.880	+1.215
September, ...	0.509	0.329	0.244	0.158	-0.265	-0.171
October, ...	0.779	0.504	0.599	0.387	-0.180	-0.117
November, ...	1.165	0.753	0.770	0.498	-0.395	-0.255
December, ...	1.822	1.178	2.103	1.359	+0.281	+0.181
Average for whole year,	1.649	1.066	1.458	0.942	-0.191	-0.124

The following table gives the rainfall upon the Nashua River watershed and the total yield expressed in inches in depth upon the watershed (inches of rainfall collected) for each of the past nineteen years, from 1897 to 1915, inclusive, together with the average for the entire period: —

Rainfall, in Inches, received and collected on the Nashua River Watershed.

MONTH.	1897.			1898.			1899.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	3.46	1.420	41.0	6.65	2.787	41.9	2.93	3.731	127.3
February, ...	2.86	1.500	52.4	3.30	2.635	79.8	5.12	1.757	34.3
March, ...	4.01	4.922	122.7	2.27	5.509	242.7	6.75	4.952	73.4
April, ...	2.32	2.818	121.5	4.43	3.500	79.0	1.94	5.829	300.5
May, ...	5.06	2.075	41.0	3.38	2.480	73.4	1.33	1.538	115.6
June, ...	5.11	2.039	39.9	3.11	1.429	46.0	5.51	0.969	17.6
July, ...	8.65	2.572	29.7	3.01	0.593	19.7	3.82	0.631	16.5
August, ...	3.47	1.599	46.1	10.61	2.363	22.3	3.20	0.421	13.2
September, ...	1.93	0.656	34.0	3.15	1.166	37.0	4.11	0.431	10.5
October, ...	0.94	0.434	46.2	7.21	2.691	37.3	2.72	0.437	16.1
November, ...	7.62	2.214	29.1	6.81	3.746	55.0	1.94	0.742	38.2
December, ...	6.41	4.059	63.3	3.99	3.676	92.1	2.03	0.640	31.5
Totals and averages, .	51.84	26.308	50.7	57.92	32.575	56.2	41.40	22.078	53.3

MONTH.	1900.			1901.			1902.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	4.56	1.420	31.1	1.75	0.926	52.9	2.72	2.990	109.9
February, ...	8.69	6.532	75.2	1.13	0.574	50.8	4.91	2.258	46.0
March, ...	6.19	6.639	107.3	5.82	4.849	83.3	5.27	7.120	135.1
April, ...	2.76	2.727	98.8	9.64	8.605	89.3	4.36	3.728	85.5
May, ...	4.34	2.467	56.8	7.02	4.867	69.3	2.24	1.839	82.1
June, ...	3.59	0.998	27.8	1.51	1.701	112.6	2.51	0.708	28.2
July, ...	3.20	0.388	12.1	5.66	0.851	15.0	3.87	0.521	13.5
August, ...	3.18	0.351	11.0	4.58	0.913	19.9	3.95	0.529	13.4
September, ...	3.46	0.220	6.4	3.10	0.552	17.8	4.26	0.416	9.8
October, ...	2.90	0.504	17.4	3.70	1.154	31.2	6.36	1.696	26.7
November, ...	6.44	1.510	23.4	2.43	0.892	36.7	0.93	1.095	117.7
December, ...	3.15	2.800	88.9	9.36	5.766	61.6	7.20	3.295	45.8
Totals and averages, .	52.46	26.556	50.6	55.70	31.650	56.8	48.58	26.195	53.9

Rainfall, in Inches, received and collected on the Nashua River Watershed —
Continued.

MONTH.	1903.			1904.			1905.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	2.85	2.256	79.2	4.02	1.176	29.3	6.10	2.258	37.0
February, ...	4.42	3.436	77.7	2.66	1.547	58.2	1.72	0.729	42.4
March, ...	6.58	6.107	92.8	3.40	5.361	157.7	3.95	5.358	135.7
April, ...	3.10	3.864	124.6	7.45	5.149	69.1	2.60	2.792	107.4
May, ...	1.24	1.015	81.9	2.99	2.671	89.3	0.83	0.794	95.7
June, ...	10.37	3.678	35.5	3.44	1.315	38.2	4.88	0.935	19.2
July, ...	3.43	1.114	32.5	3.84	0.886	23.1	5.39	0.651	12.1
August, ...	3.88	0.846	21.8	3.68	0.633	17.2	3.09	0.573	18.5
September, ...	2.93	0.647	22.1	5.30	0.853	16.1	6.90	2.119	30.7
October, ...	4.43	1.228	27.7	1.78	0.620	34.8	1.81	0.654	36.1
November, ...	2.36	1.095	46.4	1.62	0.591	36.5	2.52	0.763	30.3
December, ...	3.99	1.702	42.7	2.88	0.784	27.2	3.79	1.816	48.0
Totals and averages, .	49.58	26.988	54.4	43.06	21.586	50.1	43.58	19.442	44.6

MONTH.	1906.			1907.			1908.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	2.59	2.018	77.9	2.84	2.601	91.6	3.40	3.101	91.2
February, ...	2.74	1.654	60.4	2.32	1.115	48.0	4.82	2.896	60.0
March, ...	5.17	3.317	64.2	1.82	3.028	166.3	2.77	3.910	141.2
April, ...	3.12	3.640	116.7	2.65	2.479	93.5	2.62	2.191	83.5
May, ...	6.58	2.734	41.5	2.96	1.722	58.2	5.34	2.524	47.3
June, ...	5.95	2.043	34.3	3.54	1.334	37.7	1.29	0.696	54.0
July, ...	5.52	1.299	23.5	3.03	0.597	19.7	3.85	0.393	10.2
August, ...	4.34	1.055	24.3	1.26	0.155	12.3	6.49	0.790	12.2
September, ...	2.61	0.478	18.3	9.50	1.399	14.7	1.04	0.151	14.5
October, ...	3.95	0.945	24.0	5.68	2.465	43.4	2.12	0.282	13.3
November, ...	2.25	1.294	57.5	5.74	4.384	76.4	1.05	0.216	20.6
December, ...	4.26	1.417	33.3	4.40	3.499	79.5	3.03	0.691	22.8
Totals and averages, .	49.08	21.894	44.6	45.74	24.778	54.2	37.82	17.841	47.2

Rainfall, in Inches, received and collected on the Nashua River Watershed —
Continued.

MONTH.	1909.			1910.			1911.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	3.52	1.056	30.0	5.86	3.293	56.2	2.91	1.379	47.5
February, ...	6.10	4.119	67.5	5.24	2.972	56.7	2.43	1.007	41.4
March, ...	4.38	3.798	86.8	1.09	4.708	432.7	3.79	2.389	63.0
April, ...	5.71	4.181	73.3	3.01	1.785	59.2	2.22	2.404	108.5
May, ...	2.65	2.162	81.6	2.13	1.085	51.0	1.59	0.822	51.6
June, ...	3.03	1.090	36.0	4.36	1.422	32.6	2.37	0.606	25.5
July, ...	4.25	0.416	9.8	1.52	0.110	7.2	2.53	0.101	4.0
August, ...	3.59	0.345	9.6	3.87	0.332	8.6	5.46	0.335	6.1
September, ...	3.90	0.358	9.2	2.86	0.250	8.7	3.04	0.313	10.3
October, ...	1.70	0.160	9.4	1.40	0.122	8.7	5.24	1.280	24.4
November, ...	1.68	0.626	37.2	4.17	0.612	14.6	4.14	1.786	43.1
December, ...	4.00	0.958	24.0	2.34	0.697	29.8	3.01	1.903	63.2
Totals and averages, .	44.51	19.270	43.3	37.85	17.388	45.9	38.73	14.325	37.0

MONTH.	1912.			1913.			1914.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	2.57	1.392	54.2	3.38	2.522	74.7	3.40	1.765	52.0
February, ...	2.42	1.547	63.8	2.55	1.397	54.7	3.58	1.903	53.2
March, ...	5.69	5.050	88.8	5.58	4.037	72.4	4.33	5.595	129.1
April, ...	4.06	3.938	97.0	3.90	3.597	92.2	4.91	4.476	91.2
May, ...	5.76	3.206	55.7	3.71	1.852	49.9	3.01	3.031	100.6
June, ...	0.48	0.571	119.6	0.90	0.483	53.5	2.00	0.547	27.4
July, ...	2.65	0.240	9.1	2.37	0.034	1.4	3.92	0.588	15.0
August, ...	2.89	0.224	7.8	3.05	0.107	3.5	4.50	0.465	10.3
September, ...	2.17	0.154	7.1	4.44	0.377	8.5	0.15	—0.020	—14.0
October, ...	2.53	0.258	10.2	6.02	1.209	20.1	1.88	0.243	12.9
November, ...	4.02	0.762	18.9	2.59	1.139	43.9	2.97	0.364	12.3
December, ...	4.95	1.414	28.5	2.73	1.704	62.5	3.89	0.664	17.1
Totals and averages, .	40.19	18.756	46.7	41.22	18.458	44.8	38.54	19.621	50.9

Rainfall, in Inches, received and collected on the Nashua River Watershed —
Concluded.

MONTH.	1915.			MEAN FOR NINETEEN YEARS, 1897-1915.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January, ...	6.31	3.678	58.3	3.78	2.198	58.2
February, ...	3.32	3.159	95.3	3.70	2.249	60.8
March, ...	0.06	1.021	17,00.6	4.15	4.614	111.1
April, ...	1.80	1.599	88.9	3.82	3.643	95.5
May, ...	1.67	0.811	48.5	3.36	2.089	62.2
June, ...	3.18	0.393	12.4	3.53	1.208	34.2
July, ...	8.60	1.932	22.4	4.17	0.732	17.6
August, ...	6.90	2.955	42.8	4.32	0.789	18.3
September, ...	1.53	0.273	17.8	3.49	0.568	16.3
October, ...	3.05	0.690	22.6	3.44	0.899	26.1
November, ...	3.12	0.859	27.5	3.39	1.300	38.3
December, ...	5.11	2.424	47.5	4.24	2.101	49.6
Totals and averages, ...	44.65	19.794	44.3	45.39	22.395	49.3

The following table gives a record of the yield of the Nashua River for each of the past nineteen years, the flow being expressed in gallons per day per square mile of watershed:—

Yield of the Nashua River Watershed in Gallons per Day per Square Mile.¹

MONTH.	1897.	1898.	1899.	1900.	1901.
January, ...	796,000	1,563,000	2,092,000	796,000	519,000
February, ...	931,000	1,635,000	1,090,000	4,054,000	356,000
March, ...	2,760,000	3,038,000	2,776,000	3,722,000	2,718,000
April, ...	1,632,000	2,027,000	3,376,000	1,580,000	4,986,000
May, ...	1,163,000	1,390,000	862,000	1,382,000	2,729,000
June, ...	1,181,000	823,000	561,000	578,000	985,000
July, ...	1,442,000	333,000	354,000	217,000	477,000
August, ...	896,000	1,325,000	236,000	197,000	512,000
September, ...	380,000	676,000	250,000	127,000	320,000
October, ...	243,000	1,509,000	245,000	282,000	647,000
November, ...	1,283,000	2,170,000	430,000	875,000	517,000
December, ...	2,275,000	2,061,000	359,000	1,570,000	3,234,000
Average for whole year, ...	1,253,000	1,551,000	1,051,000	1,264,000	1,507,000
Average for driest six months, ...	886,000	1,013,000	312,000	377,000	576,000

¹ The area of the watershed used in making up these records included water surfaces amounting to 2.2 per cent. of the whole area from 1897 to 1902, inclusive, to 2.4 per cent. in 1903, to 3.6 per cent. in 1904, to 4.1 per cent. in 1905, to 5.1 per cent. in 1906, to 6 per cent. in 1907, to 7 per cent. in 1908, 1909 and 1910, to 6.5 per cent. in 1911, to 6.8 per cent. in 1912, to 7.0 per cent. in 1913 and to 7.4 per cent. in 1914 and 1915.

Yield of the Nashua River Watershed in Gallons per Day per Square Mile —
Continued.

MONTH.	1902.	1903.	1904.	1905.	1906.
January, ...	1,676,000	1,265,000	659,000	1,266,000	1,132,000
February, ...	1,401,000	2,133,000	927,000	452,000	1,027,000
March, ...	3,992,000	3,423,000	3,008,000	3,004,000	1,860,000
April, ...	2,159,000	2,238,000	2,984,000	1,617,000	2,109,000
May, ...	1,031,000	569,000	1,498,000	445,000	1,533,000
June, ...	410,000	2,131,000	762,000	542,000	1,184,000
July, ...	292,000	624,000	497,000	365,000	728,000
August, ...	297,000	474,000	355,000	321,000	591,000
September, ...	241,000	375,000	494,000	1,228,000	277,000
October, ...	950,000	639,000	347,000	367,000	530,000
November, ...	635,000	634,000	343,000	442,000	749,000
December, ...	1,848,000	954,000	440,000	1,018,000	794,000
Average for whole year, ...	1,248,000	1,285,000	1,025,000	926,000	1,043,000
Average for driest six months, ...	471,000	626,000	413,000	541,000	613,000

MONTH.	1907.	1908.	1909.	1910.	1911.
January, ...	1,458,000	1,738,000	592,000	1,846,000	773,000
February, ...	692,000	1,736,000	2,556,000	1,845,000	625,000
March, ...	1,697,000	2,192,000	2,129,000	2,639,000	1,339,000
April, ...	1,436,000	1,269,000	2,422,000	1,034,000	1,393,000
May, ...	965,000	1,415,000	1,212,000	608,000	461,000
June, ...	773,000	403,000	632,000	824,000	351,000
July, ...	335,000	220,000	233,000	62,000	57,000
August, ...	87,000	443,000	193,000	186,000	188,000
September, ...	810,000	88,000	208,000	145,000	181,000
October, ...	1,382,000	153,000	90,000	68,000	718,000
November, ...	2,540,000	125,000	363,000	354,000	1,035,000
December, ...	1,961,000	387,000	537,000	391,000	1,067,000
Average for whole year, ...	1,180,000	847,000	918,000	828,000	682,000
Average for driest six months, ...	725,000	238,000	270,000	201,000	327,000

Yield of the Nashua River Watershed in Gallons per Day per Square Mile —
Concluded.

MONTH.	1912.	1913.	1914.	1915.	Mean for Nineteen Years, 1897-1915.
January, ...	780,000	1,414,000	990,000	2,062,000	1,233,000
February, ...	927,000	867,000	1,181,000	1,961,000	1,388,000
March, ...	2,831,000	2,263,000	3,137,000	572,000	2,587,000
April, ...	2,281,000	2,033,000	2,593,000	926,000	2,113,000
May, ...	1,797,000	1,038,000	1,699,000	455,000	1,171,000
June, ...	331,000	280,000	317,000	228,000	700,000
July, ...	135,000	19,000	329,000	1,083,000	411,000
August, ...	125,000	60,000	261,000	1,657,000	442,000
September, ...	89,000	219,000	—12,000	158,000	329,000
October, ...	145,000	678,000	136,000	387,000	504,000
November, ...	442,000	660,000	211,000	498,000	753,000
December, ...	793,000	955,000	372,000	1,359,000	1,178,000
Average for whole year, ...	891,000	879,000	934,000	942,000	1,066,000
Average for driest six months, ...	210,000	318,000	208,000	666,000	522,000

Merrimack River.

The flow of the Merrimack River has been measured for many years at Lawrence, above which place the river has a total watershed area of 4,663 square miles, which includes 118¹ square miles on the South Branch of the Nashua River, 75 square miles on the Sudbury River and 18 square miles tributary to Lake Cochituate, or a combined area of 211¹ square miles from which water is drawn at the present time for the supply of the Metropolitan Water District. The flow as measured at Lawrence includes the water wasted from these three watersheds, which, in the wet months of the year, is very considerable, but which becomes very small in the dry months. Records of the quantity of water wasted have been kept by the Boston Water Board and by the Metropolitan Water and Sewerage Board, and these quantities have been deducted from the flow as measured at Lawrence. The area of the three watersheds has also been deducted from the watershed area above Lawrence, so that the net watershed area above that point was 4,567 square miles in 1880, 4,570 square miles in the years 1881 to 1897, inclusive, and 4,452 square miles since the latter year.

¹ Including 9.35 square miles from which water is drawn for the supply of the city of Worcester.

The average flow of the Merrimack River during the year 1915 amounted to 1.256 cubic feet per second, or 812,000 gallons per day, per square mile of drainage area, or 85 per cent. of the normal flow for the past thirty-six years for which records are available. The flow was in excess of the normal in the months of February, July, August, September and December and less than the normal in the remaining seven months of the year.

In order to show the relation between the flow of this stream during each month of the year 1915 and the normal flow as deduced from observations during thirty-six years, from 1880 to 1915, inclusive, the following table has been prepared:—

Table showing the Average Monthly Flow of the Merrimack River at Lawrence for the Year 1915, in Cubic Feet per Second per Square Mile of Drainage Area; also, Departure from the Normal Flow.

MONTH.	Normal Flow, 1880-1915.	Actual Flow in 1915.	Excess or Deficiency.
January, ...	1.307	1.080	—0.227
February, ...	1.443	1.742	+0.299
March, ...	2.753	1.485	—1.268
April, ...	3.674	1.788	—1.886
May, ...	2.174	1.126	—1.048
June, ...	1.177	0.489	—0.688
July, ...	0.723	1.810	+1.087
August, ...	0.686	2.064	+1.378
September, ...	0.640	0.655	+0.015
October, ...	0.812	0.657	—0.155
November, ...	1.125	0.874	—0.251
December, ...	1.228	1.303	+0.075
Average for whole year, ...	1.479	1.256	—0.223

The following table gives the record of the net flow of the Merrimack River at Lawrence for each of the past thirty-six years, the flow being expressed in cubic feet per second per square mile of net drainage area:—

Flow of the Merrimack River at Lawrence in Cubic Feet per Second per Square Mile.

MONTH.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
January, ...	1.618	0.504	1.604	0.442	1.019	1.137	2.859	1.644	1.388	2.619
February, ...	2.687	1.027	2.016	0.634	2.054	0.938	3.798	2.823	1.818	1.345
March, ...	2.292	3.641	3.483	0.861	3.339	0.738	2.581	1.769	2.168	2.385
April, ...	2.358	3.511	2.268	3.382	5.656	3.967	4.931	4.788	5.377	2.408
May, ...	1.209	3.101	2.320	1.854	2.585	1.838	1.478	3.001	4.539	1.437
June, ...	0.696	1.094	1.963	1.100	0.893	0.917	0.714	1.786	1.228	1.164
July, ...	0.646	0.751	0.687	0.684	0.500	0.623	0.497	1.458	0.548	0.782
August, ...	0.554	0.611	0.470	0.423	0.461	1.191	0.435	1.866	0.577	1.087
September, ...	0.490	0.549	0.812	0.266	0.426	0.632	0.434	0.918	1.540	0.750
October, ...	0.388	0.545	0.678	0.432	0.400	0.749	0.471	0.682	2.656	1.220
November, ...	0.929	1.157	0.505	0.627	0.522	1.988	1.538	0.966	2.888	1.924
December, ...	0.580	1.832	0.472	0.515	1.022	1.496	1.296	1.337	3.181	2.812
Average for whole year,	1.204	1.527	1.440	0.935	1.573	1.351	1.753	1.920	2.326	1.661
Average for driest six months.	0.598	0.785	0.604	0.491	0.534	0.992	0.671	1.205	1.573	1.073

MONTH.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
January, ...	1.492	2.823	1.836	0.645	0.661	0.626	1.419	0.745	1.613	1.657
February, ...	1.656	2.851	0.925	1.081	0.933	0.507	1.941	1.000	1.638	1.032
March, ...	3.326	5.041	1.562	2.281	3.115	1.258	4.510	2.294	4.042	2.479
April, ...	3.728	4.645	1.774	3.359	2.401	4.289	3.967	3.839	3.316	5.757
May, ...	3.096	1.601	2.215	4.202	1.525	1.360	0.971	2.209	2.399	2.121
June, ...	1.716	0.990	1.272	0.963	1.317	0.664	0.769	2.769	1.416	0.667
July, ...	0.691	0.633	1.040	0.522	0.498	0.565	0.446	2.359	0.585	0.556
August, ...	0.745	0.538	1.051	0.564	0.370	0.477	0.441	1.105	0.776	0.467
September, ...	1.833	0.556	0.863	0.608	0.400	0.366	0.683	0.603	0.636	0.447
October, ...	2.648	0.467	0.467	0.790	0.493	0.863	1.134	0.482	1.372	0.401
November, ...	1.918	0.540	1.420	0.736	0.772	2.047	1.454	1.274	2.094	0.625
December, ...	1.418	0.899	0.859	1.166	0.661	2.025	0.952	2.262	1.871	0.622
Average for whole year,	2.022	1.799	1.274	1.410	1.095	1.254	1.557	1.745	1.813	1.403
Average for driest six months.	1.542	0.605	0.950	0.697	0.532	0.716	0.741	1.348	1.146	0.519

Flow of the Merrimack River at Lawrence in Cubic Feet per Second per Square Mile — Concluded.

MONTH.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
January, ...	0.748	0.752	2.268	1.684	0.584	0.855	1.705	1.411	1.946
February, ...	3.520	0.546	1.196	1.979	0.644	0.503	1.133	0.667	1.648
March, ...	3.441	2.063	6.011	6.031	2.719	2.349	1.677	1.728	2.499
April, ...	4.087	5.568	3.801	3.375	4.494	3.615	3.591	2.923	2.652
May, ...	2.185	3.342	2.255	0.979	3.843	1.169	2.269	2.034	2.570
June, ...	0.878	1.656	1.187	2.224	1.016	0.931	2.262	1.190	0.932
July, ...	0.407	0.644	0.970	1.032	0.624	0.600	1.106	0.749	0.522
August, ...	0.420	0.989	0.844	0.734	0.573	0.606	0.741	0.431	0.668
September, ...	0.338	0.588	0.774	0.530	0.653	1.706	0.422	0.664	0.379
October, ...	0.564	0.913	1.600	0.826	0.816	0.727	0.549	1.433	0.330
November, ...	1.304	0.654	1.285	0.665	0.604	0.760	0.707	2.914	0.354
December, ...	1.486	2.054	1.755	0.825	0.407	1.274	0.566	2.177	0.420
Average for whole year, . .	1.615	1.647	1.995	1.740	1.415	1.258	1.394	1.527	1.243
Average for driest six months, .	0.652	0.907	1.110	0.769	0.613	0.888	0.682	1.083	0.445

MONTH.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	Mean for Thirty- six Years, 1880-1915.
January, ...	0.677	1.043	0.624	0.802	1.775	0.734	1.080	1.307
February, ...	1.563	0.973	0.482	0.706	0.987	0.958	1.742	1.443
March, ...	1.695	3.611	1.248	2.773	3.372	3.245	1.485	2.753
April, ...	3.404	2.445	3.045	4.323	2.490	4.954	1.788	3.674
May, ...	1.951	1.509	1.360	2.297	1.442	2.880	1.126	2.174
June, ...	0.948	1.077	0.551	1.304	0.899	0.737	0.489	1.177
July, ...	0.447	0.398	0.266	0.412	0.393	0.559	1.810	0.723
August, ...	0.376	0.458	0.328	0.499	0.306	0.434	2.064	0.686
September, ...	0.369	0.397	0.435	0.485	0.387	0.445	0.655	0.640
October, ...	0.422	0.300	0.918	0.733	0.791	0.303	0.657	0.812
November, ...	0.388	0.457	1.049	1.239	0.967	0.356	0.874	1.125
December, ...	0.504	0.335	1.284	1.069	1.046	0.437	1.303	1.228
Average for whole year, . .	1.062	1.084	0.966	1.387	1.238	1.337	1.256	1.479
Average for driest six months, .	0.418	0.391	0.591	0.739	0.624	0.422	1.092	0.860

Sudbury, Nashua and Merrimack Rivers.

The following table shows the weekly fluctuation during the year 1915 in the flow of the three streams just described, namely, the Sudbury River at Framingham, the South Branch of the Nashua River above Clinton, and the Merrimack River at Lawrence. The flow of these streams, particularly that of the Sudbury and of the South Branch of the Nashua River, serves to indicate the flow of other streams in eastern Massachusetts. The area of the Sudbury River watershed is 75.2 square miles and of the South Branch of the Nashua River 118.19 square miles. The net watershed area of the Merrimack River is 4,452 square miles.

Table showing the Average Weekly Flow of the Sudbury, South Branch of the Nashua and Merrimack Rivers for the Year 1915 in Cubic Feet per Second per Square Mile of Drainage Area.

WEEK ENDING SUNDAY —	FLOW IN CUBIC FEET PER SECOND PER SQUARE MILE.			WEEK ENDING SUNDAY —	FLOW IN CUBIC FEET PER SECOND PER SQUARE MILE.		
	Sudbury River.	South Branch Nashua River.	Merrimack River.		Sudbury River.	South Branch Nashua River.	Merrimack River.
Jan. 3, ...	0.272	0.574	0.353	July 4, ...	2.543	2.280	0.896
10, ...	1.419	2.275	0.630	11, ...	2.483	2.447	3.250
17, ...	2.500	2.654	0.843	18, ...	1.215	1.140	2.047
24, ...	5.442	7.373	2.102	25, ...	0.746	0.775	1.007
31, ...	1.606	1.618	1.113	Aug. 1, ...	0.717	1.738	1.224
Feb. 7, ...	1.552	1.938	0.721	8, ...	4.276	7.131	2.907
14, ...	1.796	1.373	0.911	15, ...	2.163	1.983	2.600
21, ...	4.122	3.081	1.468	22, ...	0.695	0.779	1.519
28, ...	4.128	5.744	3.869	29, ...	0.308	0.827	1.637
Mar. 7, ...	1.599	1.195	2.509	Sept. 5, ...	0.788	0.429	0.896
14, ...	1.118	0.968	1.341	12, ...	0.151	0.225	0.608
21, ...	0.828	0.728	1.043	19, ...	—0.496	0.306	0.571
28, ...	0.509	0.719	1.155	26, ...	0.138	0.339	0.626
Apr. 4, ...	0.672	1.010	1.069	Oct. 3, ...	0.185	0.306	0.575
11, ...	1.409	2.069	1.461	10, ...	1.071	0.843	0.725
18, ...	1.011	1.685	3.113	17, ...	0.272	0.611	0.719
25, ...	0.466	0.995	1.487	24, ...	0.088	0.424	0.692
May 2, ...	0.797	1.001	1.633	31, ...	0.091	0.386	0.618
9, ...	0.417	1.132	1.732	Nov. 7, ...	0.033	0.340	0.655
16, ...	0.193	0.605	1.130	14, ...	0.193	0.212	0.657
23, ...	0.789	0.677	0.816	21, ...	0.763	1.616	0.945
30, ...	0.027	0.371	0.666	28, ...	0.533	0.834	1.182
June 6, ...	—0.045	0.176	0.560	Dec. 5, ...	0.442	0.681	0.960
13, ...	0.103	0.215	0.431	12, ...	0.845	0.344	0.735
20, ...	0.096	0.451	0.422	19, ...	2.011	2.531	0.712
27, ...	0.008	0.197	0.515	26, ...	1.954	3.393	1.539

METHODS OF SEWAGE DISPOSAL.

The systems of sewage disposal in use by large cities in this State and elsewhere may be divided into three general classes, — (1) disposal by chemical methods, (2) disposal by filtration or the so-called bacterial methods, and (3) disposal by dilution.

CHEMICAL PRECIPITATION.

Works for the chemical treatment of sewage have been in operation in the city of Worcester for many years continuously under the charge of competent experts, and the results of this method of treatment have been published fully in the reports of the department having charge of the sewers.

The chemical precipitation works at Worcester have cost about \$270,000. The total quantity of sewage treated by this process in the year 1915 averaged 11,960,000 gallons daily, and for the treatment of this sewage 2,289 tons of lime were used, or 1,048 pounds per million gallons of sewage treated.

Concerning this treatment and its effect, the following statements are quoted from the annual report of the superintendent of sewers of the city of Worcester for the year ending Nov. 30, 1915: —

There has been a decided increase in the amount of lime used, as compared with last year — 2,289 tons, an increase of 214 tons. This represents 1,048 pounds per million gallons of sewage. The increase is due to an attempt to thoroughly treat all acid iron doses which come while operating chemical precipitation. In spite of the great amount of work which has been done in an endeavor to have these wastes more evenly distributed and of a more dilute nature by a slower discharge we find that it is necessary to use large quantities of lime in a very short period of time in order to maintain an alkaline treatment throughout the dose.

The sludge produced by chemical precipitation amounted to 23,347,000 gallons, an average of 5,346 gallons per million gallons of sewage treated. This is the greatest volume of sludge produced per million gallons of sewage in recent years and is due to the treatment of the iron doses. The resulting sludge from the treatment of these doses is light and flocculent and decreases in volume by compacting or standing. The actual quantity of dry solids per million gallons of sewage was 1.24 tons.

It was impossible to press all the sludge produced by chemical precipitation and 4,950,000 gallons, containing 1,251 tons of dry solids, were pumped on to the old sludge beds. The remainder of the sludge, 18,397,000 gallons, was pumped to the storage basins, 3,164,000 gallons of clear water drawn off, and the remaining sludge pressed. There has been hauled to the dump by the trolley motor car 16,973 tons of cake, containing 4,887 tons of dry solid matter. The farmers continue to haul about 3,500 to 4,000 tons each year.

During each winter it is necessary to remove from the six roughing basins of our chemical precipitation plant the accumulation of refuse which has come from the milk of lime tanks, consisting principally of sand, unburnt lime and a small proportion of sludge. In February 651 cubic yards of this refuse were removed at a cost of \$410.04, representing 63 cents per cubic yard. The first two basins retained about five-ninths of the total quantity.

The effluent from chemical precipitation is of slightly improved quality over that of last year. The removal of total organic matter, measured by albuminoid ammonia is 41.64 per cent.; of suspended organic matter, 76.56 per cent.; both figures are slightly greater than those of last year.

The total cost of the operation of these works in the year 1915 is given in the report as follows:—

	Total.	Per Million Gallons.
Cost of chemical precipitation, ¹	\$23,127 39	\$5 29
Sludge pressing, ...	19,223 78	4 93
Total, ...	\$42,351 17	\$10 22

¹ The Worcester sewage contains much iron, which is an advantage in this treatment.

The cost includes a portion of the amount expended for the maintenance of a laboratory in connection with the operation of these works.

The sewage is delivered to the precipitation works by gravity, and the effluent is discharged also by gravity into the Blackstone River. It will be seen that under efficient operation by experts at the city of Worcester the total removal of organic matter from the sewage is only about 40 per cent., and of the suspended organic matter about 75 per cent. The effluent from such a works is capable of causing objectionable conditions if discharged into most of the rivers of the State, but where an adequate quantity of water for its proper dilution is available at all times and where the danger of the organic matter causing a nuisance upon neighboring shores or flats exposed by the tide can be avoided, this method is permissible.

FILTRATION.

The second general method of sewage disposal is that of filtration, or bacterial treatment sometimes so called, and at the end of 1915 there were 34 cities and towns in the State having an aggregate population of about 538,000 which had provided works for the filtration of a part or all of their sewage. This treatment is effected in a variety of ways, the principle being practically the same in each. Two general methods of applying this treatment have been found successful in actual practice in the disposal of sewage in Massachusetts communities. The first of these methods, and the one which has been longest in use, is intermittent filtration of the sewage through beds of sand or gravel, a method which has been found most efficient and satisfactory for the purification of the sewage of most of the cities and towns mentioned in the appended tables. This method is used for the disposal of part of the sewage of the city of Worcester where upon 72.6 acres of filter beds constructed of sand and gravel a quantity of sewage amounting to an average of 4,459,000 gallons per day was treated during the year 1915. The total cost of these filters, not including land, was about \$4,300 per acre. The total cost of maintenance in the year 1915 was \$17,988.90, or about \$11.06 per million gallons of sewage treated. The rate of operation was about 61,000 gallons per acre per day.

Another large works in which this method is also used for the purification of the sewage is that of the city of Brockton, where a large part of the sewage amounting to an average of 1,449,000 gallons per day is treated on an extensive area composed of sand and gravel suitable for the purpose. The total cost of these filters, not including land, was about \$3,500 per acre, and the cost of maintenance in the year 1915 was \$10.20 per million gallons. The rate of operation of these filters was about 48,000 gallons per acre per day.

It is no doubt practicable with such a system of treatment to reduce the area of filters required by preliminary treatment of the sewage in sedimentation tanks, though no material saving in expense is likely to be effected by any practicable preliminary treatment, nor is it likely that a very material reduction in the area of the filters, even in the beginning, would be effected thereby.

In some cases objectionable odors arising from the sludge removed from the settling tanks have led to the abandonment of the settling tanks. At three of the sewage-disposal works, namely, Attleboro, Spencer and Westborough, the sewage is discharged on to the filter beds without preliminary treatment, and at Worcester the portion

of the sewage treated by the sand filters receives very little treatment previous to filtration. At Brockton, Clinton, Concord, Framingham, Marion, Natick and Pittsfield reservoirs are provided from which the sewage is pumped to the filter beds. Formerly the heavier matters settling out in these reservoirs were pumped to beds set apart for the purpose, but now, with the exception of one or two of these places, the sludge is distributed over the various filters with the sewage. When the heavier suspended matters are not removed by settling tanks the work of cleaning the filter beds is somewhat increased, but the objectionable features, due to the disposal of sludge, are considerably reduced.

The second method of filtration is known as the sprinkling or trickling filter and consists in applying the sewage in a fine spray at frequent intervals to filters 5 to 10 feet in depth composed of broken stone with a diameter usually of 1 to 3 inches. The sewage is commonly first treated for sedimentation, sometimes in two-story sedimentation tanks known as Imhoff tanks, and the effluent also requires treatment in settling tanks for the removal of suspended matters therefrom. The results of the operation of such filters show that they are less effective in the purification of sewage than intermittent sand filters, but a sufficient degree of purification can be effected by this method of filtration to render the effluent satisfactory, provided it is subsequently diluted in an adequate body of water. Such works have recently been constructed in the cities of Fitchburg and Brockton, and in the former city have been in operation for about a year, treating an average of about 2,000,000 gallons per day. These works have cost thus far about \$321,000 and have an estimated capacity for filtering 5,000,000 gallons of sewage per day, while the tanks have sufficient capacity for treating effectively about 6,800,000 gallons per day. The total area of filters in use is 2.14 acres. The tanks are of the Imhoff design and afforded a period of sedimentation with the flow measured in 1915 of about two and three-quarters hours. These tanks were partially reconstructed during the year, but the operation of the trickling filter has presented no difficulty. The cost of operation thus far has been about \$11.50 per million gallons.

One of the objections to this method of disposing of sewage, as in the case of other treatment works, is the difficulty of securing a location for the works where danger of a nuisance can be avoided. The operation of the trickling filters at both Brockton and Fitchburg has been attended by offensive odors, but at Brockton — due to the fact that the filter is largely surrounded by a thick growth of trees — these odors have not been noticeable in any populated neighborhood.

The Activated Sludge Method of Sewage Disposal.

In the course of the experimental work at the Lawrence Experiment Station, Mr. H. W. Clark, chemist of the State Department of Health, began in 1912 experiments upon the treatment of sewage with growths of organisms and aeration. This work is described in the annual report of the State Board of Health for the year 1912, and in subsequent reports.

These experiments have been continued and have been taken up and further developed both at Lawrence and elsewhere in this country and abroad. The results of the experiments thus far made indicate that by aerating sewage in tanks designed for the purpose containing sludge, the sewage, after the sludge in the tanks becomes seeded with the necessary organisms, can within a few hours under favorable conditions be purified apparently nearly to the degree of purification effected by trickling filters. The experiments indicate, furthermore, that the process can be carried on at such rates that this method may be a practicable one for the treatment of the sewage of cities and towns. The process is still in its experimental stage, however, and awaits the tests of practical experience on a considerable scale. So far as the experiments show, a very considerable area of tanks would be required for the treatment of any large quantity of sewage, and a large quantity of air would be required in the process. It is impracticable at the present time to indicate with certainty whether or not serious odors will attend this process. There seems danger, however, that considerable odor may arise from such works in view of the large quantities of air that must be passed through the sewage.

Screening.

Coarse screens or racks are commonly employed in connection with sewage-disposal works, especially where the sewage is pumped or where it passes through siphons or tunnels, for the purpose of removing larger objects which might injure pumping machinery or obstruct pipes or conduits. Such screens are usually constructed of bars set from half an inch to an inch apart and intercept only the larger objects floating in the sewage, including small amounts of paper, rags, etc.

Fine screening, on the other hand, is a method of sewage treatment designed to remove the smaller organic particles in suspension and thus reduce the quantity of organic matter in the sewage. The screening of sewage for this purpose is carried on at a number of works in

this country and at numerous works abroad, commonly in connection with a further process of sewage treatment. In Massachusetts this method is employed at Brockton in connection with sewage disposal works there for the removal of a part of the suspended organic matter from the sewage before its application to the filters.

The efficiency of screens appears to depend to a considerable extent upon the character of the sewage treated, and their effect is apparently much the same as that of sedimentation when treating sewages of the character commonly discharged from cities and towns in Massachusetts. The method has certain advantages which may make its employment desirable, especially in cases where the removal of the larger particles of suspended organic matter from sewage is desirable, as, for example, before the discharge of fresh sewage into a river or waterway having an adequate flow for the proper dilution of the sewage.

Disinfection.

The disinfection of sewage for the purpose of destroying disease germs by the introduction of a chemical such as hypochlorite of lime is practised at some of the disposal works in this country and abroad, though there is no case in which the sewage or effluent from an existing works in Massachusetts is treated in this way. It is practicable by treating well-clarified sewage effluents to reduce very greatly the number of bacteria contained therein, and the method may be employed to advantage where the effluent is discharged into waters subsequently used for water-supply purposes or into waters in which shellfish are grown. Its efficiency in the treatment of raw sewage containing considerable quantities of suspended matter is commonly of little practical value, and its advantages are most valuable in the further improvement of effluents from treatment works where a high degree of purification of the sewage is desirable.

Detailed information regarding the more important sewage filtration works will be found after the discussion of the next method of sewage disposal.

DISPOSAL BY DILUTION.

The disposal of sewage by dilution is a method commonly employed by cities and towns in Massachusetts situated on the larger rivers or bordering upon the sea. A description of the various sea outlets now in use, of the circumstances affecting these outlets, and the results obtained at each is given below.

BOSTON MAIN DRAINAGE OUTLET.

The oldest of the important modern sewer outlets through which large quantities of sewage are discharged into the sea is the Moon Island outlet of the main drainage system of the city of Boston, completed and first put in operation in January, 1884.

The sewers of the city of Boston were constructed originally upon the combined plan receiving both sewage and storm water, and the sewage was discharged originally at numerous outlets into the harbor and other waters about the city where it produced most objectionable conditions. It was impracticable to convey all of the flow of the sewers to a suitable place of disposal, and when the main drainage works, so called, were designed, of which the Moon Island outlet is a part, provision was made for taking all of the dry-weather flow of the various sewers, together with a quantity of storm water equivalent to about one-fourth of an inch of rain in twenty-four hours over the area drained by the sewers. This arrangement was not applied equally throughout the district, however, since there were certain low areas in the southern part of the city subject to flooding at times of heavy rain when the tide was high, and provision was made in the design for favoring these low areas by taking a greater proportion of the flow of storm water therefrom and a smaller quantity from the higher districts, thus relieving to some extent the flooding of streets and buildings in the lower sections of the city.

For several years after the construction of the works the area tributary to the main drainage system included only that portion of the city of Boston lying south of Charles River. The design provided, however, for the admission of sewage temporarily from neighboring areas and for the subsequent construction of a system of intercepting sewers at a higher level to relieve the main drainage works when the capacity of the latter had been reached. In 1892, upon the completion of the Charles River valley sewer, sewage from the cities of Waltham and Newton, the towns of Brookline and Watertown, and the Brighton district of the city of Boston was discharged into the main drainage system, and still later, by the completion of a sewer in the Neponset valley, sewage was brought to the Moon Island outlet from the towns of Dedham, Hyde Park and Milton. In the districts added to the main drainage system outside the city of Boston the sewers had been constructed on the separate plan and storm water was excluded, but the addition of considerable quantities of sewage reduced the capacity of the main drainage system for the removal of storm water from areas sewered on the combined plan in the city of Boston and caused the

discharge of large quantities of mingled sewage and storm water into local waters.

In 1904 the high-level sewerage system was completed and the sewage of the Charles and Neponset river valleys, including also the sewage of the high levels in the West Roxbury and Dorchester districts of the city of Boston, was removed to a new outlet known as the Nut Island outlet, near Peddocks Island in Boston Harbor, and the conditions affecting the Moon Island outlet were restored as contemplated in the original design. In more recent years it has been found necessary, in order to prevent the excessive pollution of local waters, to separate the sewage from the storm water in the territory tributary to the Charles River within the limits of the city, and further provision has been made for the relief of the low areas in the southern districts by pumping the mingled sewage and storm water into the harbor at times of heavy rain. In consequence of these changes there has been considerable variation in the quantity of sewage delivered at the Moon Island outlet, the maximum quantity having been reached just previous to the completion of the high-level sewer in 1904.

The average quantity of sewage discharged at the Moon Island outlet amounts at the present time to about 100,000,000 gallons per day. The sewage of the intercepting sewers is all delivered at a pumping station at Calf Pasture, where it is elevated several feet to deposit sewers, so called, which are small settling tanks designed for the sedimentation of sand and other heavy matters, and is then conveyed through a tunnel beneath Dorchester Bay to reservoirs at Moon Island, whence it is discharged into the sea, generally in the first two hours of the outgoing tide. In consequence of its slow passage through the intercepting sewers and the deposit sewers at Calf Pasture and its storage in the reservoirs at Moon Island previous to discharge, the sewage becomes considerably decomposed and putrefied when it reaches the outlet and has a more offensive odor than that of fresh sewage.

The sewer outlet at Moon Island is located at the northerly corner of the island, and the sewage is discharged at the level of the water. The sewage passes out of the harbor chiefly between Long and Rainsford islands and after each discharge becomes thoroughly mingled with the water of the sea and does not return on the incoming tide.

Numerous chemical analyses have been made from time to time of the sewage discharged at this outlet and of the waters of the harbor in the region through which the sewage flows, the results of which show that the sewage, while becoming diluted quite rapidly, has a tendency to float away from the outlet upon the surface of the water in a shallow layer, which on the whole, however, notwithstanding the great quantity of sewage discharged, amounting to about 25,000,000

gallons per hour, mingles quickly with the water and is usually dispersed within an hour after the discharge has ceased.

The following table shows the results of analyses of samples of the sewage and of the sea water within about 1,000 feet of the outlet before and during a discharge in August, 1915:—

	PARTS IN 100,000.					Bacteri- per Cubic Cen- timeter.
	Free Ammo- nia.	ALBUMINOID AMMONIA.			Chlo- rine.	
		Total.	In Solu- tion.	In Sus- pension.		
Moon Island Wharf, before discharge, .	.0175	.0175	.0130	.0045	1,620.0	-
Sewage flowing from Moon Island reser- voirs.	2.4700	.9590	.3490	.6100	272.0	-
600 feet off gate house, surface, . . .	.5600	.3760	.0680	.3080	1,260.0	100,800
600 feet off gate house, 20 feet below surface.	.0450	.0490	.0275	.0215	1,590.0	28,000
At farther limit of sewage field, 1,000 feet from outlet.	.2130	.1350	.0590	.0760	1,570.0	144,000

The foregoing samples are probably fairly representative of the conditions at this outlet. As the sewage field moves away from the outlet it passes chiefly around the southerly end of Long Island and continues toward the sea in a northeasterly direction, chiefly between Long and Rainsford islands. On calm days the sewage greatly discolors the water for a distance of from half a mile to a mile from the outlet and remains for a time upon the surface of the sea, which is covered with a greasy film. This film is very thin and usually extends well beyond the area otherwise affected by the sewage. The area covered by the sewage or in which sewage is recognizable varies greatly with the condition of the sea. On very calm days the area affected is extensive, covering 600 to 700 acres of the harbor surface between Moon, Long and Rainsford islands. Under ordinary conditions, however, the area visibly affected by the sewage is smaller, and when a considerable wind is blowing the area in which the sewage is noticeable is much less than in calm weather.

Under ordinary conditions the sewage mingles rapidly with the water and quickly ceases to be recognizable after the discharge has ceased. Analyses of the water of the harbor through which this sewage is discharged twice daily show that its effect rapidly disappears and that the sewage does not return on the incoming tide. Analyses of the water from various stations in different parts of the area over which this sewage flows twice daily are given in the following table, the location of the stations at which the samples were taken being shown on the chart which follows the table:—

Examinations of Water in the Portion of Boston Harbor through which the Moon Island Sewage flows to Sea.

[Examinations made in the summer of 1913.]

STATION.	Minutes after High Water.	Distance from Outlet (Feet).	PARTS IN 100,000.						BACTERIA PER CUBIC CENTIMETER.				
			FREE AMMONIA.		ALBUMINOID AMMONIA.		CHLORINE.		Surface.	At 20 Feet.			
			Surface.	At 20 Feet.	Surface.	At 20 Feet.	Surface.	At 20 Feet.					
31.	.	.	.	.	400	1.1200	.0315	.4500	.0275	1,120.0	1,750.0	1,100,000	5,000
4.	.	.	.	.	2,600	{	.0700	-	.0240	-	1,713.0	-	-
	.	.	.	.									
3.	.	.	.	.	4,200	{	.4560	-	.1080	-	1,460.0	-	-
	.	.	.	.									
45.	.	.	.	.	5,800	.0245	.0210	.0160	.0175	1,770.0	1,770.0	120	240
15.	.	.	.	.	8,200	.0305	-	.0145	-	1,755.0	-	-	-
44.	.	.	.	.	11,600	.0200	.0213	.0145	.0155	1,775.0	1,760.0	400	390
22.	.	.	.	.	15,300	.0260	-	.0125	-	1,745.0	-	-	-
43.	.	.	.	.	18,500	.0240	.0240	.0165	.0160	1,770.0	1,765.0	1,800	400
41.	.	.	.	.	25,900	.0190	-	.0140	-	1,770.0	-	700	-

From this table it will be seen that at station 31, located 400 feet from the outlet, the surface of the sea was covered with sewage practically in an undiluted condition. At station 3, a distance of 4,200 feet from the outlet, two hours after the sewage was discharged, that is, at about the end of the discharge, the quantity of sewage in the water, as indicated by the albuminoid ammonia, was 24 per cent., and as indicated by the free ammonia about 41 per cent., of the amount found at station 31, located 400 feet from the outlet. At station 15, a distance of 8,200 feet from the outlet, the organic matter present in the sea water, as shown by the free and albuminoid ammonia, is no greater than the average of the harbor waters in the inner parts of the harbor.

During the period when the sea is covered with sewage from this outlet the odor is objectionable when sailing through the sewage field, and this condition prevails for a period of two to three hours on each tide. During the summer season temporary deposits of sludge from the sewage take place along the wall adjacent to the sewer outlet, but these deposits are carried away by the winter storms. There is no evidence that matters from the sewage tend to accumulate upon the bottom of the harbor or the adjacent shores in this region, except the temporary deposits already referred to, caused by the eddying of the sewage against the long wall at the easterly end of Moon Island.

So far as can be judged from numerous careful examinations, the conditions about this outlet have shown no noticeable change since the works were first established thirty-two years ago. The pollution of a considerable area of the sea to such an extent as to be offensive to sight and smell, as happens in the neighborhood of this outlet at the time the sewage is discharged, especially on calm days, is objectionable, and no doubt the objections to this condition will increase with the rapidly increasing use of the harbor as a place of recreation in the summer season and the undoubtedly increasing attention that is paid by the public to objectionable conditions caused by offensive odors.

Before the outlet was constructed careful observations of the tidal currents were made by means of floats and the probable course taken by the sewage ascertained as carefully as practicable. The actual results have shown the accuracy of the conclusions drawn from the preliminary tests. The outlet represents the first important works constructed in Massachusetts to dispose of large quantities of sewage by dilution in the water of the sea.



NORTH METROPOLITAN SEWER OUTLET.

The next important sewer outlet constructed for the disposal of sewage into the sea is that of the north metropolitan sewerage system, designed in 1889 and put in operation early in 1894. This outlet is located near the Deer Island beacon at the northerly side of the entrance to Boston Harbor, and the sewage is discharged at about the level of low water. The sewage brought to this outlet is collected from the cities and towns of Arlington, Belmont, Lexington, Woburn, Winchester, Wakefield, Stoneham, Melrose, Malden, Everett, Medford, Somerville, Cambridge, Revere and Winthrop, and the Charlestown and East Boston districts of the city of Boston. The sewers in most of the cities and towns of the north metropolitan sewerage district are constructed upon the separate plan, but the sewers in the older sections of the district, especially in Cambridge, Somerville, Chelsea, and the Charlestown and East Boston districts of Boston, are constructed upon the combined plan and receive both sewage and storm water. In this case, as in Boston, the dry-weather flow of sewage and a certain portion of storm water are admitted to the system, and the remainder of the flow at times of storm is discharged into local waters.

In the course of the investigations relative to the disposal of the sewage of the north metropolitan system, careful studies were made of the volume and movement of the tides near the outer end of Deer Island, the results showing that a much larger volume of water would be available at this point for the dilution of the sewage than is the case at Moon Island and that the velocity of flow of tidal currents is considerably greater than in the smaller channel into which the Moon Island sewage is discharged.

As a result of these studies the conclusion was reached that the sewage could be discharged to advantage at all stages of the tide with less effect upon the waters of the harbor than if large quantities were discharged at one time, and the plan selected provided for continuous discharge at all stages of the tide. The actual results obtained by this method of sewage disposal corresponded to the conclusions reached as the result of the careful preliminary investigations. The sewage brought to this outlet is discharged as it comes, without storage at any point. There are several pumping stations along the line of the main sewer and its tributaries, and while the flow is continuous, on account of the great length of the system, a part of the sewage is many hours in reaching the outlet. The sewers of this system receive large quantities of manufacturing waste from tanneries, rendering works and other estab-

ishments, and the total quantity of sewage discharged in the year 1915 amounted to 60,300,000 gallons per day, or about 111 gallons per person connected with the sewers, the total population connected with the sewers amounting to 542,575. On the incoming tide the sewage flows toward the harbor and is noticeable under most favorable conditions for somewhat more than half a mile from the outlet. Toward high tide the sewage can be detected in the water on fairly calm days for a distance of three-quarters of a mile, and the oily film known as "sleek" is usually observable over a larger area. During the outgoing tide the sewage flows directly to sea and is detectable at about the same distances as on the incoming tide, though in a somewhat narrower area. As the quantity of sewage discharged at this point increased it covered a larger area of the sea and was noticeable at times on vessels passing into and out of the harbor and became objectionable to the keepers of the light. It has been decided to extend this outlet to deep water, which is reached within a short distance of the present outlet, and the works for this extension are already under construction.

SALEM AND PEABODY.

Following the installation of the outlet of the north metropolitan sewerage system at Deer Island, works were designed for the disposal of the sewage of Salem and Peabody into Salem Harbor near Great Haste Island. These works were designed in 1895 but were not constructed until 1906. The average quantity of sewage discharged at this outlet in 1915 was 7,560,000 gallons per day. The outlet is located at a point in Salem Harbor where the depth of water is 7 feet at low tide, and the sewage is discharged continuously at the approximate rate at which it is received at the pumping station, the average rate of discharge consequently being a little over 300,000 gallons per hour.

The effect of the discharge of sewage at this outlet has been observed from time to time since it was first used, and samples of the water of Salem Harbor in the neighborhood of the outlet and elsewhere have been analyzed from time to time. An examination of this outlet in 1915 shows that the area of the sea visibly affected by the sewage varies greatly with different conditions of wind and tide. With winds of considerable velocity the area affected is limited to less than 1,000 feet from the outlet, while in very calm days the sewage is noticeable for a maximum distance of half a mile, though the thin oily film known as "sleek" is noticeable for greater distances.

There is no doubt that the outlet could be greatly improved and

the area of the sea affected by the sewage very materially diminished if the outlet were extended to deep water, which can be reached at no great distance beyond its present location.

THE DISPOSAL OF SEWAGE FROM THE SOUTH METROPOLITAN SYSTEM INTO THE SEA NORTH OF PEDDOCKS ISLAND.

The sewage disposal works of the south metropolitan system were designed in 1899-1900 and completed in 1904. The system receives the sewage of the cities and towns in the Charles and Neponset river valleys formerly tributary to the Boston main drainage system, the sewage of the higher districts in the southerly part of the city of Boston, and the sewage of the city of Quincy. The estimated population connected with the sewers in this system in 1915 was 300,435, and the total quantity of sewage discharged during the year 1915 was 52,300,000 gallons per day, or 174 gallons per person connected with the sewers. The main sewer operates wholly by gravity, but the sewage of the Charles River valley district, and of a portion of the Back Bay district of the city of Boston tributary to this system, is pumped into the upper end of the high-level sewer at Roxbury. A part of the sewage of Quincy also is pumped into the main sewer in that city. The sewer terminates at Nut Island, whence two pipes are laid beneath the bottom of the sea to outlets into the deep channel known as Nantasket Roads in the southerly part of Boston Harbor, one outlet being located 1 mile north of Nut Island and the other 1,500 feet easterly therefrom. The depth of water over the westerly outlet at low tide is 27 feet and over the easterly outlet 30 feet.

In the course of the studies which led to the selection of these outlets the experience acquired in the disposal of sewage at the sewer outlets already described was carefully considered, especially the rapid disappearance of the sewage when thoroughly diffused in water, and the outlets were placed at the bottom of the sea at a point where a large quantity of water is available for dilution at all times in order to secure a greater diffusion of the sewage than takes place where the outlet is located near the surface of the sea. The results of the discharge of sewage at these outlets show the great advantages in the dilution of the sewage obtained where the discharge takes place at a considerable depth as compared with discharge near the surface of the sea. In order to determine the degree of dilution of the sewage that takes place before it reaches the surface and the condition of the sea water immediately over the outlets, samples of water were taken very carefully immediately over the outlet in use at different times in the

past year. In the first test, made on Aug. 25, 1915, samples were collected from a tug when passing immediately over the outlet. The results of the analyses show that the quantity of free and albuminoid ammonia present in the water at this time amounted to about 5 per cent. of that found in the sewage, while the maximum number of bacteria was less than 2 per cent. of the number present in the sewage. It was found, moreover, at this time that the effect of the sewage upon the sea water near the outlet diminished with very great rapidity as the distance from the outlet increased, and later on additional samples were taken with the aid of rowboats immediately over the outlet itself.

The results of these tests with analyses of the sewage flowing from the sewer at this time, together with samples taken at different depths, are shown in the following table:—

Table showing Analyses of the Sewage and of the Water immediately over the Nut Island Sewer Outlet, Oct. 14, 1915.

	Hour A.M.	PARTS IN 100,000.					Bacteria per Cubic Cen- timeter.
		Free Ammo- nia.	ALBUMINOID AMMONIA.			Chlo- rine.	
			Total.	In Solu- tion.	In Sus- pension.		
Sewage, ...	8.30	1.7600	.4500	.1400	.3100	53.5	610,000
Surface over outlet, . . .	9.13	.1440	.0590	.0280	.0310	1,560.0	316,800
Surface over outlet, . . .	9.33	.1950	.0725	.0305	.0420	1,620.0	290,400
Surface over outlet, . . .	9.53	.2400	.0770	.0385	.0385	1,540.0	277,200
Surface over outlet, . . .	10.13	.1220	.0550	.0235	.0315	1,570.0	38,200
10 feet below surface, . . .	10.20	.0750	.0340	—	—	1,650.0	25,080
20 feet below surface, . . .	10.25	.0480	.0175	—	—	1,690.0	—

In the above tests the maximum amount of albuminoid ammonia found in any of the samples collected immediately above the outlet was 14 per cent. of the amount present in the sewage, while the average quantity of free ammonia obtained in the surface samples was 10 per cent. of the amount found in the sewage. The maximum amount of free ammonia found in any sample was 17 per cent. of that of the sewage, and the average amount 14 per cent.

Samples were collected at the same time in the line in which sewage was flowing from the outlet and at various distances therefrom. The average results of the analyses of several samples at each station are shown in the following tables:—

Samples of Harbor Water collected in Path taken by the Sewage from the Nut Island Outlet.

STATION.	Hours after Release of Floats.	Miles from Outlet.	Feet from Outlet.	PARTS IN 100,000.			Bacteria per Cubic Cen- timeter.
				Free Ammo- nia.	Total Albu- minoid Am- monia.	Chlo- rine.	
Screen house (sewage), ...	-	-	-	1.7600	.4500	53.5	610,000
A (at outlet), ...	-	-	-	.1753	.0659	1,572.5	230,650
B, ...	0.50	0.04	200	.0555	.0210	1,670.0	26,080
C, ...	1.00	0.05	260	.0242	.0165	1,710.0	525
D, ...	1.50	0.27	1,400	.0330	.0177	1,765.0	46,220
E, ...	2.62	0.47	2,500	.0165	.0145	1,720.0	850
G, ...	2.87	0.66	3,500	.0130	.0140	1,730.0	180

Samples of Harbor Water collected from Points outside Path of Sewage from the Nut Island Outlet.

STATION.	Hours after Release of Floats.	Miles from Outlet.	Feet from Outlet.	PARTS IN 100,000.			Bacteria per Cubic Cen- timeter.
				Free Ammo- nia.	Total Albu- minoid Am- monia.	Chlo- rine.	
F, ...	2.70	0.82	4,300	.0100	.0175	1,740.0	700
H, ...	2.95	0.43	2,300	.0170	.0115	1,720.0	4,800
I, ...	3.12	0.23	1,200	.0120	.0095	1,740.0	130
J, ...	3.28	0.28	1,500	.0115	.0130	1,750.0	400

It will be noted that in the sample collected at Station D, 1,400 feet from the outlet, the amount of free ammonia represents less than 2 per cent. and the amount of albuminoid ammonia 4 per cent. of the quantity present in the sewage.

The remaining samples collected at greater distances show the presence of very much smaller quantities of organic matter, and numerous examinations along the path which this sewage takes, determined with the aid of floats and at various times, fail to show a quantity of free ammonia exceeding 0.0170 parts in 100,000 or an amount of albuminoid ammonia exceeding 0.0175 parts in 100,000. A comparison of the analyses of harbor waters in the immediate neighborhood of this outlet

and along the course followed by the sewage with waters in other parts of the harbor shows that, except within a distance of about 1,400 feet from the outlet, the quantity of free and albuminoid ammonia in the water is no greater at the surface of the harbor and at points 20 feet below the surface than is found in the harbor waters at points far removed from sewer outlets.

Samples of Harbor Waters collected at Points remote from Sewer Outlets.

[Parts in 100,000.]

	FREE AMMONIA.		ALBUMINOID AMMONIA.	
	Surface.	Twenty Feet below Surface.	Surface.	Twenty Feet below Surface.
Hingham Bay, ...	.0159	.0169	.0137	.0141
In the outer channels of harbor along a line running approximately northwest from Point Allerton.	.0178	.0132	.0160	.0160
Off Outer Brewster Island, ...	.0065	.0115	.0120	.0165
Ocean off East Point, Nahant, ...	.0060	-	.0135	-

The total number of bacteria found in the sample of sea water collected off Nahant was 300 per cubic centimeter. Samples taken from the sea several miles beyond Outer Brewster Island on the incoming tide indicate that the quantity of free ammonia in the water of the sea many miles from the coast is 0.0025 of a part in 100,000 and the bacteria 25 per cubic centimeter.

Comparisons of the foregoing tests show very clearly that the waters of the harbor generally are higher in bacteria and in organic matter, as shown by the free and albuminoid ammonia, than the waters of the sea, a condition which is inevitable in view of the large quantity of waste matter that must find its way into the waters near the coast, not only from sewer outlets but from the sewage and waste from vessels, and especially from rivers and other waters flowing into the sea from populous areas such as those which surround Boston Harbor. The examination of the sea beyond a distance of 1,400 feet from the Nut Island outlet at the time the recent test was made failed to show any sewage matter or other effect objectionable to the senses. Furthermore, the analyses of the water in the region beyond this limit, when compared with waters along the beaches used by large numbers of bathers in the summer season, indicate that, so far as pollution goes or any visible effect of the sewage, the condition of the harbor water was better beyond a distance of 1,400 feet from this sewer outlet than

the waters used by large numbers of bathers at the beach resorts near the city.

A comparison of the results of analyses of the waters from different bathing beaches with the analyses of waters about the Nut Island sewer outlet at the time of the test in October last is shown in the following table:—

Table showing Comparison of Analyses of Sea Water off the Nut Island Outlet with Sea Water at Popular Beaches.

Nut Island Outlet.

DISTANCE FROM OUTLET.		Free Ammonia (Parts in 100,000).	Bacteria (per Cubic Centimeter).
Miles.	Feet.		
0.47	2,500	.0165	850
0.66	3,500	.0130	180

Samples collected at the Surface of the Sea at Various Points in Front of Bathhouse at Nahant Beach.¹

Analysis Number.	Free Ammonia (Parts in 100,000).	Bacteria (per Cubic Centimeter).	B. COLI. ²			
			0.1 Cubic Cen- timeter.	1.0 Cubic Cen- timeter.	10.0 Cubic Cen- timeters.	100 Cubic Cen- timeters.
124963	.0500	200	0	0	+s	+s
124964	.0200	101	0	0	0	0
124965	.0100	100	0	0	0	+s
124966	.0720	432	0	0	+	+
124967	.0145	500	0	0	+	+

Samples from Surf along Revere Beach, July 18, 1915.

124968	.0520	1,200	+s	+s	+	+
124969	.0590	3,700	0	+s	+	+s
124970	.0550	2,100	0	+	+	+
124971	.0570	2,400	0	+	+s	+
124972	.0490	1,500	+s	+s	+	+
124973	.0380	2,200	0	+	+	+
124974	.0280	5,600	0	+	+s	+
124975	.0115	7,900	0	+	+	+

¹ Samples collected on July 18, 1915, with large numbers of bathers along the beach.

² + signifies presence of *B. coli*. s signifies presence of sewage streptococcus.

The samples generally were collected about 100 feet from shore, but sample 124975 was collected 600 feet from shore and beyond the line of bathers, these samples being taken at about high tide.

The appearance and the general condition of the water at these bathing beaches were not objectionable at the time these samples were collected, though a marine growth (*Cladophora*) was present in a considerable quantity in the water along the Nahant Beach. The results show clearly that the waters at the surface of the harbor are not affected in the neighborhood of the sewer outlets at Nut Island by the ordinary quantity of sewage discharged there in such a way as to be noticeable or even detectable by chemical analysis beyond a limit of less than half a mile in the region immediately about the outlet itself. These examinations were made when the rate of discharge was approximately 1,380,000 gallons per hour and when the depth of water over the outlet was about 30 feet.

OTHER DEEP-SEA OUTLETS.

In view of the very satisfactory results obtained from the discharge of sewage into deep water north of Nut Island, this practice has been followed in the construction of new outlets into the sea since that time at Swampscott, New Bedford and Manchester.

At Swampscott the sewage is discharged at a point where the depth of water at low tide is approximately 50 feet, and while the average quantity of sewage discharged at this outlet amounts only to about 1,000,000 gallons per day, the sewage in this case is stored in a reservoir before discharge, so that it has been practicable, by storing the sewage as long as possible, to obtain a rate of discharge at this outlet amounting to 3,100,000 gallons per day for a period of one and one-quarter hours. The results of this test were similar to the experience at Nut Island. Observations about the outlet during this period show that the presence of the sewage is not noticeable to sight or smell beyond a very limited area extending some 300 feet from the outlet, and that the quantity of organic matter in the water at a distance of 1,300 feet from the outlet was no greater, as shown by chemical analysis, than is found in waters bordering populous shores remote from sewer outlets.

A new deep-sea outlet has recently been constructed for the city of New Bedford, the population of which by the census of 1915 amounted to 109,568. This sewer outlet is located at a point 3,300 feet south of the extreme end of Clark's Point in Buzzards Bay, where the depth of water at low tide is about 30 feet. A very careful examination was made of this outlet on two occasions during the past

year, and samples were collected along the line taken by floats launched at the sewer outlet. The results of these observations show that sewage was noticeable only in a limited area in the immediate neighborhood of the outlet and was not traceable with certainty by chemical or bacterial analysis beyond a distance of 1,000 feet.

The results of the observations at New Bedford and Swampscott are shown in the following table, and the locations of the stations at which samples were taken are indicated on the accompanying chart: —

Table showing Results of Analyses of Water in the Path of the Sewage from the New Bedford Sewer Outlet.

Aug. 9, 1915.

STATION.	Hours after Release of Floats.	Distance from Outlet (Miles).	Distance from Outlet (Feet).	PARTS IN 100,000.			Bacteria per Cubic Centimeter.
				Free Ammonia.	Total Albuminoid Ammonia.	Chlorine.	
A (outlet), ...	—	—	—	.1276	.0323	1,589.0	—
1, ...	0.52	0.21	1,100	.0025	.0225	1,710.0	—
2, ...	1.02	0.44	2,600	.0025	.0180	1,690.0	—
3, ...	1.52	0.82	4,300	.0025	.0165	1,690.0	—
4, ...	1.99	1.14	6,030	— ¹	— ¹	— ¹	—
5, ...	2.48	1.46	7,680	.0005	.0195	1,690.0	—

¹ Bottle broken.

Sept. 24, 1915.

A (outlet), ...	—	—	—	.0207	.0224	1,697.0	219,850
6, ...	0.32	0.15	800	.0165	.0205	1,740.0	2,650
7, ...	0.82	0.35	1,800	.0077	.0125	1,755.0	27
8, ...	1.32	0.49	2,600	.0045	.0096	1,757.0	17
9, ...	1.82	0.60	3,150	.0072	.0114	1,735.0	63
10, ...	2.32	0.92	4,900	.0050	.0140	1,757.0	95

Table showing Results of Analyses of Water collected from Stations outside the Area affected by Sewage from New Bedford.

Aug. 9, 1915.

STATION.	Hours after Release of Floats.	Distance from Outlet (Miles).	Distance from Outlet (Feet).	PARTS IN 100,000.			Bacteria per Cubic Centimeter.
				Free Ammonia.	Total Albuminoid Ammonia.	Chlorine.	
11, ...	0.77	0.61	3,200	.0100	.0145	1,740.0	-
12, ...	1.18	0.65	3,400	.0120	.0160	1,722.5	-

Sept. 24, 1915.

13, ...	0.53	1.17	6,180	.0025	.0125	1,750.0	25
14, ...	2.17	1.00	5,280	.0060	.0165	1,750.0	99
15, ...	2.87	0.61	3,200	.0025	.0095	-	65
16, ...	3.03	1.25	6,580	.0065	.0140	-	163

Table showing Results of Analyses of Water in the Path of the Sewage from the Swampscott Sewer Outlet.

July 19, 1915.

A (outlet), ...	-	-	-	.0758	.0395	1,648.8	-
6, ...	0.83	0.310	1,600	.0085	.0125	1,690.0	-
7, ...	2.07	0.470	2,500	.0045	.0125	1,700.0	-
8, ...	2.90	0.630	3,300	.0085	.0170	1,690.0	-

Oct. 1, 1915.

A (outlet), ...	-	-	-	.1264	.0417	1,702.5	99,750
1, ...	0.18	0.028	150	.0405	.0320	1,700.0	38,800
2, ...	0.68	0.057	300	.0320	.0370	1,725.0	21,500
3, ...	1.18	0.250	1,300	.0127	.0225	1,750.0	2,400
4, ...	1.68	0.310	1,600	.0033	.0140	1,765.0	13
5, ...	2.18	0.390	2,100	.0030	.0130	1,740.0	66

Table showing Results of Analyses of Water collected from Stations outside the Area affected by Sewage from Swampscott.

July 19, 1915.

STATION.	Hours after Release of Floats.	Distance from Outlet (Miles).	Distance from Outlet (Feet).	PARTS IN 100,000.			Bacteria per Cubic Centimeter.
				Free Ammonia.	Total Albuminoid Ammonia.	Chlorine.	
9, ...	2.32	0.360	1,900	.0050	.0085	1,608.0	-
10, ...	— ¹	0.140	740	.0055	.0110	1,700.0	-
11, ...	0.32	1.570	8,300	.0035	.0110	1,700.0	-

¹ Eleven minutes before.

Oct. 1, 1915.

12, ...	2.12	0.390	2,100	.0045	.0100	1,740.0	0
13, ...	2.33	0.210	1,100	.0025	.0100	1,810.0	22
14, ...	2.43	0.230	1,200	.0015	.0100	1,760.0	0

Comparing the various sea outfalls where sewage is discharged into deep water, especially those of the south metropolitan district, New Bedford and Swampscott, it is found that the dilution of the sewage by the time it reaches the surface of the sea is very great, amounting so far as shown by the albuminoid ammonia to about 85 per cent. in the case of the south metropolitan outlet at Nut Island, where the quantity discharged at a single outlet amounts to 2,500,000 gallons per hour, to 98 per cent. in the investigations conducted at Swampscott, where the discharge during the period of observation was at the rate of 3,000,000 gallons per day, and to 94 per cent. at New Bedford. These comparative results are shown in the following table:—

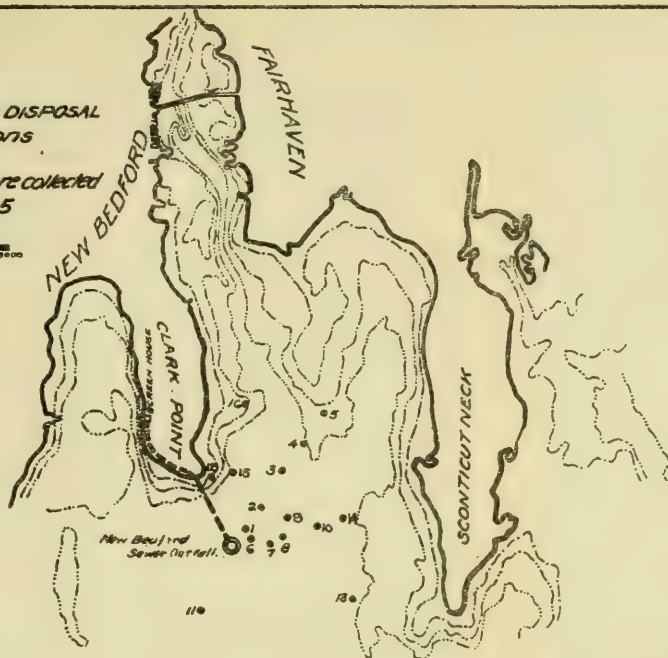
Table showing Comparison of Results obtained by the Disposal of Sewage by Dilution.

	NEW BEDFORD.						SOUTH METROPOLITAN OFF NUT ISLAND.						SWAMPSCOTT.					
	FIRST EXPERIMENT.			SECOND EXPERIMENT.			FIRST EXPERIMENT.			SECOND EXPERIMENT.			FIRST EXPERIMENT.			SECOND EXPERIMENT.		
	Sewage.	Sea Water over Outfall.	Per Cent. Removal.	Sewage.	Sea Water over Outfall.	Per Cent. Removal.	Sewage.	Sea Water over Outfall.	Per Cent. Removal.	Sewage.	Sea Water over Outfall.	Per Cent. Removal.	Sewage.	Sea Water over Outfall.	Per Cent. Removal.	Sewage.	Sea Water over Outfall.	Per Cent. Removal.
Free ammonia (parts in 100,000), . . .	1.8202	0.1276	93	1.8202	0.0207	99	1.7600	0.1752	90	5.2000	0.0757	98	6.2000	0.1264	98	-	-	-
Total albuminoid ammonia (parts in 100,000), . . .	0.5302	0.0323	94	0.5302	0.0224	96	0.4500	0.0659	85	1.8700	0.0395	98	2.0800	0.0417	98	-	-	-
Dissolved albuminoid ammonia (parts in 100,000), . . .	-	0.0203	-	-	0.0192	-	0.1400	0.0301	79	0.5850	0.0220	96	0.6000	0.0250	96	-	-	-
Suspended albuminoid ammonia (parts in 100,000), . . .	-	0.0120	-	-	0.0031	-	0.3100	0.0358	89	1.2850	0.0175	99	1.4800	0.0167	99	-	-	-
Chlorine (parts in 100,000), . . .	5.2500	1,600.0	-	5.2500	1,697.5	-	53.5000	1,572.5	-	16.2700	1,649.0	-	15.0000	1,702.5	-	-	-	-
Bacteria per cubic centimeter, . . .	-	-	-	-	219,850	64 ¹	610,000	230,700	62	-	-	-	-	99,750	84 ¹	-	-	-

¹ On assumption that sewage had 610,000 bacteria per cubic centimeter.

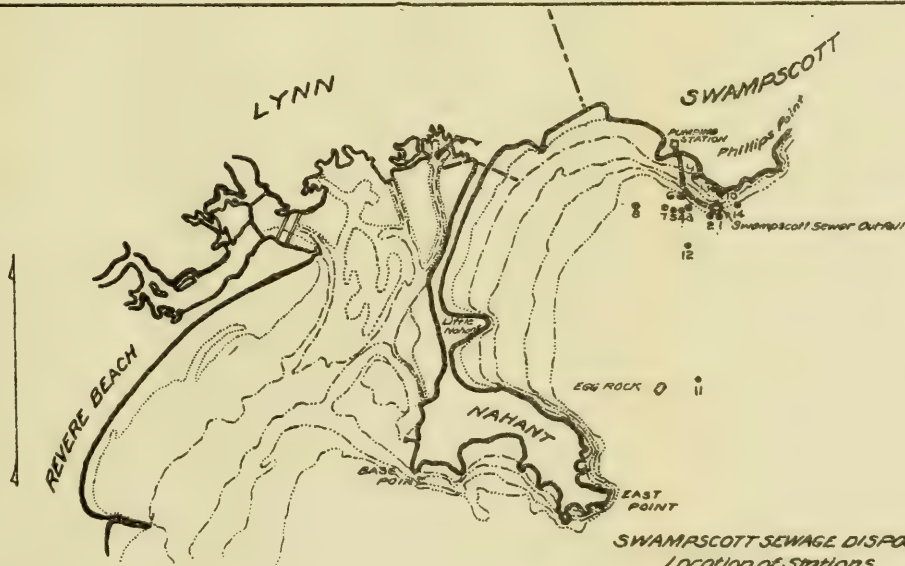
NEW BEDFORD SEWAGE DISPOSAL
Location of Stations
at which
Samples of sea water were collected
September 24, 1915

0 2000 4000 6000 8000



LYNN

SWAMPSCOTT



SWAMPSCOTT SEWAGE DISPOSAL
Location of Stations
at which
Samples of Sea water were collected
July 19, and October 1, 1915

0 2000 4000 6000 8000

Furthermore, by setting off floats at the various outlets and taking samples along the path taken by the sewage, as indicated by the floats, it was found that the quantity of organic matter attributable to sewage in the water into which the sewage is discharged, so far as shown by chemical analysis, falls within a period of less than an hour after the discharge of the sewage to an amount comparable with that found in waters bordering populous shores distant from sewer outlets and in waters adjacent to bathing beaches used by large numbers of people.

The results of the experience with the various systems of sewerage in the State having outlets into the sea show conclusively that this method of disposal may result in great nuisances where large quantities of sewage are discharged near the shores and in shallow waters. Even when discharged into large tidal volumes the sewage, if discharged at the surface, may spread over a considerable area before becoming thoroughly diffused in the water of the sea. But where the sewage is discharged at the bottom of the sea in depths of 30 feet or more of water, where the tidal volume is at all times ample for the dilution of the sewage, the sewage mingles rapidly with the sea water, becoming diluted by the time it reaches the surface of the sea to an extent comparable in degree of purification with that effected by the most efficient methods of sewage disposal. Even when large quantities of sewage are discharged at one point, as at Nut Island in Boston Harbor, the area of surface of the sea over which the sewage can be seen reaches less than half a mile from the outlet, and beyond that distance the effect upon the waters of the sea, as shown by chemical and bacterial analysis, is no different from that which is caused by other conditions, such as pollution from shipping and the natural washings from populated shores.

CONDITION OF SEWAGE-DISPOSAL WORKS.

During the year the town of Franklin completed the construction of its sewage-disposal works, but they were not put into operation until about the end of the year and no analytical results have been obtained. The works consist of settling and dosing tanks and 11 sand filter beds, having an aggregate area of about 3.24 acres, constructed of sand and gravel of good quality for the purpose and suitably under-drained.

At Andover, where an extension of the sewer system is under construction, an additional sludge bed has been provided and a large

quantity of soil has been handled preparatory to increasing the area of filter beds.

At Hopedale the filtration works have been improved and extended, the addition making an aggregate filtration area of 3.79 acres.

At Framingham considerable attention has been given to the filters in the removal of clogged surface soil and in the construction of additional underdrains, so that at present 11 of the various filter beds are adequately underdrained and their efficiency increased.

At Pittsfield the area of the sewage filters has been increased nearly 50 per cent., so that early in 1916 the aggregate area of filters available will be about 41.15 acres. The quantity of sewage discharging upon these filters has been increased greatly during the last two or three years, and a further additional area will soon be required for the adequate purification of this sewage.

A large part of the sewage now discharging at the Amherst sewage-disposal works will soon be diverted to the Connecticut River through sewers constructed during the year, but it will still be necessary to use the existing works for the disposal of the sewage of a portion of the town.

Owing to the heavy rainfall in January, July and August there has been in general a slightly greater amount of leakage into the various sewerage systems than usual. On the whole the year has been a rather difficult one for the successful management of sewage-disposal works, but very little complaint due to overflow of sewage or to offensive odors arising from the various works has reached this Department. It has been observed, however, that more care is required for the efficient operation of many of the filtration works. It is still very difficult for the municipal officers having charge of sewerage works to obtain a sufficient appropriation for the proper maintenance and necessary extensions of such works.

The following tables contain the results of chemical analyses of sewage and effluent from the more important sewage-disposal works, together with general information as to the design, construction and maintenance of the works:—

TABLE No. 1. — *Average Results of the Analyses of Monthly Samples of Sewage as received at the Disposal Works, 1915.*
[Parts in 100,000.]

City or Town.	RESIDUE ON EVAPORATION.						AMMONIA.			Chlorine.	OXYGEN CONSUMED.		Kjeldahl Nitrogen.	IRON.		Pats.	
	TOTAL RESIDUE.			LOSS ON IGNITION.			Free.	ALBUMINOID.			Unfiltered.	Filtered.		Unfiltered.	Filtered.		
	Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.		Total.	Dissolved.								Suspended.
Amherst, ¹	62.63	50.37	12.26	24.00	13.17	10.83	2.79	.86	.55	.31	14.18	3.55	5.40	1.70	.243	.057	6.18
Andover,	63.26	36.39	26.87	34.28	12.84	21.44	3.72	1.01	.52	.49	7.48	3.75	7.07	1.87	.326	.081	14.25
Attleboro,	39.43	12.15	27.28	22.88	12.82	10.06	3.93	.94	.57	.37	8.18	3.33	5.18	1.72	.200	.085	13.07
Brookton,	96.58	64.88	31.67	51.67	23.68	27.99	5.95	1.53	.81	.72	14.78	10.12	14.94	2.79	.325	.105	13.50
Clinton,	96.80	56.82	39.98	53.65	23.57	30.08	3.92	1.46	.81	.65	7.28	6.41	9.78	2.74	.392	.120	28.22
Concord,	44.98	24.04	20.94	27.44	8.69	18.75	2.05	.68	.34	.34	4.32	2.21	4.24	1.42	—	—	9.04
Fitchburg,	50.60	33.68	16.92	21.65	11.20	10.45	2.06	.70	.38	.32	7.43	3.47	5.18	1.29	—	—	5.46
Frammingham,	108.48	60.48	48.00	62.85	23.66	39.19	5.15	1.73	1.00	.73	10.05	7.38	13.98	3.19	.353	.082	21.14
Gardner (Gardner area),	111.53	63.47	48.06	64.55	23.73	40.82	4.96	2.22	1.34	.88	15.47	8.28	13.28	3.90	.278	.069	16.15
Gardner (Templeton area),	70.53	48.80	21.73	38.33	19.02	19.31	9.20	1.72	1.13	.59	10.39	5.91	9.51	3.02	.180	.065	8.18
Hopedale,	63.77	39.67	24.10	36.64	16.98	19.66	6.79	1.60	.95	.65	7.24	9.08	9.08	2.74	—	—	8.81
Hudson,	205.63	152.07	53.56	73.50	30.92	42.58	5.15	2.30	1.31	.99	55.52	8.53	14.63	4.29	.260	.057	17.27
Leicester, ¹	60.83	35.47	25.36	39.47	16.33	23.14	2.37	.93	.56	.37	3.95	5.76	8.35	1.71	.177	.067	13.07
Marion, ¹	23.27	16.77	6.50	9.95	5.34	4.61	.83	.36	.17	.19	3.40	1.93	1.26	.69	.290	.060	1.37
Marlborough,	81.91	52.13	29.78	38.44	16.14	22.30	5.22	1.25	.65	.60	14.34	6.08	9.79	2.44	.205	.081	12.01
Milford,	71.77	51.67	20.10	35.82	18.49	17.33	3.64	1.11	.72	.39	9.83	4.65	7.25	1.80	.182	.060	13.39
Natick,	52.37	44.02	8.35	21.25	14.20	7.05	3.53	.71	.44	.27	8.58	4.84	8.24	1.34	.242	.072	4.54
North Attleborough, ¹	32.14	19.27	12.87	14.93	4.71	10.22	.92	.65	.25	.40	3.81	3.25	1.24	1.39	.129	.045	3.96
Northbridge,	41.18	28.75	12.43	22.73	12.30	10.45	2.84	.82	.47	.35	5.31	4.01	5.53	1.63	—	—	7.23
Norwood,	116.93	90.78	26.15	36.84	17.00	19.84	4.19	1.12	.49	.63	34.51	9.95	5.82	2.00	.376	.096	5.48
Pittsfield,	47.03	31.78	15.25	22.71	11.02	11.69	2.49	.83	.47	.36	4.68	5.33	5.33	1.81	.210	.057	4.18
Southbridge,	71.05	40.18	30.87	43.36	16.91	26.45	6.10	1.56	.88	.68	7.20	11.11	6.17	2.86	.222	.065	15.50
Spencer,	41.17	29.35	11.82	21.68	11.57	10.11	3.64	.95	.56	.39	5.18	5.60	3.76	1.73	.162	.059	4.24
Stockbridge, ¹	29.00	23.63	5.37	11.83	7.73	4.10	1.26	.36	.20	.16	2.16	2.40	2.40	1.79	.70	—	2.45
Westborough,	59.83	42.77	17.06	27.70	13.47	14.23	3.25	.98	.54	.44	11.03	7.48	5.33	1.70	.275	.142	6.06
Worcester (day),	106.06	71.34	34.72	40.48	15.20	25.28	3.24	1.25	.47	.78	14.79	12.50	6.05	2.66	4.520	.558	7.22
Worcester (night),	92.73	63.50	29.23	38.33	18.75	19.58	2.26	.98	.37	.61	9.17	10.82	5.42	2.05	8.300	3.721	5.81

¹ Every other month.

TABLE NO. 2. — *Average Results of the Analyses of Monthly Samples of Sewage as applied to Filter Beds after Preliminary Treatment as indicated.*

[Parts in 100,000.]

CITY OR TOWN.	Form of Preliminary Treatment.	RESIDUE ON EVAPORATION.			AMMONIA.			OXYGEN CONSUMED.		IRON.		Kjeldahl Nitrogen.	Fats.					
		TOTAL RESIDUE.		LOSS ON IGNITION.		Free.	ALBUMINOID.		Unfiltered.	Filtered.	Unfiltered.			Filtered.				
		Total.	Dissolved.	Suspended.	Total.		Dissolved.	Suspended.										
Amherst, ¹	Tanks,	61.13	45.90	15.23	27.23	13.57	13.66	2.95	.83	.53	.30	10.99	5.87	3.77	.153	.070	1.51	4.85
Andover,	Tank,	47.21	40.02	7.19	20.13	14.08	6.05	4.39	.81	.52	.29	8.74	4.92	3.93	.122	.063	1.58	7.47
Attleboro,	None,	51.58	39.43	12.15	22.88	12.82	10.06	3.93	.94	.57	.37	8.18	5.18	3.33	.200	.085	1.72	5.07
Brockton,	Revolving screen,	89.81	62.90	26.91	46.98	23.43	23.55	5.86	1.49	.76	.73	14.18	14.23	9.58	.302	.103	2.57	9.06
Clinton,	None, ²	96.80	56.82	39.98	53.65	23.57	30.08	3.92	1.46	.81	.65	7.28	9.78	6.41	.392	.120	2.74	28.22
Concord,	None, ³	44.98	24.04	20.94	27.44	8.69	18.75	2.05	.68	.34	.34	4.32	4.24	2.21	—	—	1.42	9.04
Fitchburg,	Imhoff tanks,	37.05	32.55	4.50	12.96	9.87	3.09	2.12	.45	.32	.13	7.34	3.48	3.01	—	—	—	2.19
Frammingham,	None, ³	108.48	60.48	48.00	62.85	23.66	39.19	5.15	1.73	1.00	.73	10.05	13.98	7.38	.353	.082	3.19	21.14
Gardner (Gardner Area),	None,	111.53	63.47	48.06	94.55	23.73	40.82	4.96	2.22	1.34	.88	15.47	13.28	8.28	.278	.060	3.90	16.15
Gardner (Templeton area),	Tanks,	35.48	28.70	6.78	15.77	10.02	5.75	3.69	.74	.44	.30	5.41	3.89	2.73	.133	.060	1.14	4.47
Hopedale,	Tanks,	39.48	32.93	6.55	18.68	13.18	5.50	4.40	.72	.48	.24	5.83	4.24	3.38	—	—	1.23	4.95
Hudson,	Tanks,	109.40	96.00	13.40	35.87	24.07	11.80	5.18	1.36	.96	.40	29.54	6.01	4.55	.140	.056	1.89	3.65
Leicester, ¹	Tank,	31.57	24.43	7.14	12.57	8.33	4.24	1.69	.37	.24	.13	3.97	2.64	1.90	.327	.173	.80	4.71
Marion, ¹	None,	23.27	16.77	6.50	9.95	5.34	4.61	.83	.36	.17	.19	3.40	1.93	1.26	.290	.066	.69	1.37
Marlborough,	Tanks,	50.42	40.68	9.74	20.26	12.22	8.04	4.87	.84	.54	.30	9.41	4.99	3.73	.135	.060	1.57	3.50
Milford,	Tanks,	55.24	45.55	9.69	23.05	15.27	7.78	3.48	.82	.52	.30	9.55	5.04	3.42	.131	.053	1.33	6.30
Natick, ¹	None, ³	52.37	44.02	8.35	21.25	14.20	7.05	3.53	.71	.44	.27	8.58	4.84	3.73	.242	.072	1.34	4.54
North Attleborough, ¹	Tanks,	21.10	19.53	1.57	5.57	4.29	1.28	.77	.18	.12	.06	4.33	1.21	1.01	.084	.049	.34	1.40
Northbridge,	Tanks,	26.75	22.37	4.38	12.15	8.77	3.38	2.45	.49	.33	.16	4.74	2.85	2.30	—	—	.89	3.50
Norwood,	Tank,	73.40	58.58	14.82	25.10	12.94	12.16	3.93	.76	.36	.40	18.98	7.80	4.36	.298	.092	1.35	4.06
Pittsfield,	None, ³	47.03	31.78	15.25	22.71	11.02	11.69	2.49	.83	.47	.36	4.68	5.33	3.28	.210	.057	1.81	4.18
Southbridge,	Tanks,	45.45	37.75	7.70	20.75	14.89	5.86	4.16	.70	.30	.26	8.32	3.58	4.55	.165	.087	1.35	4.54
Spencer,	None,	41.17	29.35	11.82	21.68	11.57	10.11	3.64	.95	.36	.39	5.18	5.60	3.76	.162	.059	1.73	4.34
Stockbridge, ¹	None,	29.00	23.63	5.37	11.83	7.73	4.10	1.26	.36	.20	.16	2.16	2.40	1.79	—	—	.70	2.45
Westborough,	None,	59.83	42.77	17.06	27.70	13.47	14.23	3.25	.98	.54	.44	11.03	7.48	5.33	.275	.142	1.70	6.06
Worcester (day),	None,	106.06	71.34	34.72	40.48	15.20	25.28	3.24	1.25	.47	.78	14.79	12.50	6.05	4.520	.558	2.66	7.22

¹ Every other month.² Settling basins abandoned.³ Coarse bar screens. Storage reservoir at pumping station.

TABLE No. 3. — Efficiency of Settling Tanks and Other Forms of Preliminary Treatment as indicated by Foregoing Tables of Analyses.
[Parts in 100,000.]

CITY OR TOWN.	Form of Preliminary Treatment.	SUSPENDED SOLIDS.			TOTAL ALBUMINOID AMMONIA.			OXYGEN CONSUMED.			FATS.			CHLORINE.		Approximate Period of Sedimentation, assuming Tank contains no Deposits (Hours).	Frequency of Cleaning Tanks.
		Raw Sewage.	Settled or Treated Sewage.	Per Cent. removed.	Raw Sewage.	Settled or Treated Sewage.	Per Cent. removed.	Raw Sewage.	Settled or Treated Sewage.	Per Cent. removed.	Raw Sewage.	Settled or Treated Sewage.					
Amherst, ¹	Tanks,	12.26	15.23	73	.86	.83	4	5.40	5.87	6.18	4.85	21	10.99	14.18	$1\frac{1}{2}$ -2	Once in two to four weeks.	
Andover,	Tank,	26.87	7.19	73	1.01	.81	20	7.07	4.92	14.25	7.47	48	8.74	7.48	8.74	Three times during the year.	
Brookton,	Revolving screen,	31.67	26.91	15	1.53	1.43	3	14.94	14.23	13.50	9.06	33	14.78	14.18	14.18	One tank once in two weeks	
Fitchburg,	Imhoff tanks, ³	16.92	4.50	73	.70	.45	36	5.18	3.48	5.46	2.19	60	7.43	7.34	3-10	except in coldest weather	
Gardner (Templeton area).	Tanks,	21.73	6.78	69	1.72	.74	57	9.51	3.89	8.18	4.47	45	10.39	5.41	$5\frac{1}{2}$ -7 $\frac{1}{2}$	Others once or twice a year.	
Hopedale,	Tanks,	24.10	6.55	73	1.60	.72	55	9.98	4.24	8.81	4.05	44	7.24	5.83	20-40	Yearly.	
Hudson,	Tanks,	53.56	13.40	75	2.30	1.36	41	14.63	6.01	17.27	3.65	79	55.52	29.54	15-28	Once in two to three weeks in summer. Once or twice in winter.	
Leicester, ¹	Tank,	25.36	7.14	72	.93	.37	60	8.35	2.64	13.07	4.71	64	3.95	3.97	-	Once in three weeks.	
Marlborough,	Tanks,	29.78	9.74	67	1.25	.84	33	9.79	4.99	12.01	3.50	71	14.34	9.41	$3\frac{3}{4}$ -5 $\frac{1}{2}$	Twice a year.	
Milford,	Tanks,	20.10	9.69	52	1.11	.82	26	7.25	5.04	13.39	6.30	53	9.83	9.55	-	Yearly.	
North Attleborough, ¹	Tanks,	12.87	1.57	88	.65	.18	72	3.25	1.21	3.96	1.49	62	3.81	4.33	$3\frac{1}{2}$ -2	Yearly.	
Northbridge,	Tanks,	12.43	4.38	65	.82	.49	40	5.53	2.85	4.99	2.23	52	5.31	4.74	-	Monthly except in coldest weather.	
Norwood,	Tank,	26.15	14.82	43	1.12	.76	32	9.95	7.80	5.48	4.06	26	34.51	18.98	$1\frac{1}{2}$ -2	Six times during the year.	
Southbridge,	Tanks,	30.87	7.70	75	1.56	.76	51	11.11	5.68	15.50	4.54	71	7.20	8.32	$4\frac{1}{2}$ -11	Monthly excepting July and August.	
Worcester,	Chemical precipitation.	29.23	7.96	73	.98	.53	46	10.82	4.68	5.81	2.42	58	9.17	9.08	7	Once in two to six weeks.	

¹ Samples collected every other month.² Very short period.³ Five tanks. All in use up to May 14, after which only two were used. Direction of flow reversed six times.⁴ Regulated so as to get good sedimentation but so as not to produce a septic effluent.

TABLE No. 4. — *Average Results of the Analyses of Monthly Samples of Sewage applied to the Trickling Filters at Brockton and Fitchburg, and of their Effluents, etc. Per cents. removed, etc.*

Brockton.

[Parts in 100,000.]

	RESIDUE ON EVAPORATION.			AMMONIA.				Chlorine.	NITROGEN AS		OXYGEN CONSUMED.		IRON.		Remarks.		
	LOSS ON IGNITION.			Free.	ALBUMINOID.				Nitrates.	Nitrites.	Unfiltered.	Filtered.	Unfiltered.	Filtered.			
	Total.	Dissolved.	Suspended.		Total.	Dissolved.	Suspended.										
Screened sewage as applied to trickling filter.	79.77	53.98	25.79	38.95	17.35	21.60	7.54	1.38	.66	.72	13.86	10.82	6.39	.210	.081	9.76	The trickling filter has an area of .5 of an acre and a depth of 5.5 to 6.5 feet of crushed stone from 1.5 to 3 inches in size. The average rate of operation was 1,314,000 gallons per acre per day.
Effluent from trickling filter.	65.49	47.15	18.34	29.30	13.88	15.42	3.95	.98	.41	.57	11.69	7.06	3.47	.200	.066	3.00	
Per cent. removed,	18	-	29	25	-	29	48	29	-	21	-	35	-	-	-	69	
Settled effluent from trickling filter. Applied to sand filters.	55.59	43.07	7.52	20.08	13.35	6.73	3.58	.62	.33	.29	12.16	4.83	3.59	.125	.065	1.87	Period of sedimentation three and one-quarter to eight hours. Tank cleaned once or twice a month except in winter.
Per cent. removed,	15	-	59	31	-	56	9	37	-	49	-	32	-	-	-	38	
Per cent. removed by trickling filter and settling tank.	30	-	71	48	-	69	53	55	-	60	-	55	-	-	-	81	

Fitchburg.

Imhoff tank effluent as applied to trickling filter.	37.05	32.55	4.50	12.96	9.87	3.09	2.12	.45	.32	.13	7.34	-	-	3.48	3.01	-	-	2.19	The trickling filter has an area of 2.14 acres and a depth of 10 feet of crushed stone from 1 to 48 inches in size. The average rate of operation was about 900,000 gallons per acre per day. Period of sedimentation averaged about two and three-quarters hours. The tanks were cleaned three times during the year.
Effluent from trickling filter.	38.28	32.01	6.27	12.28	9.47	2.81	1.03	.31	.17	.14	7.35	.5036	.0226	1.91	1.28	-	-	1.61	
Per cent. removed,	-	-	-	5	-	9	.51	31	-	-	-	-	-	45	-	-	-	26	
Settled effluent from trickling filter. Discharged to river.	33.28	31.16	2.12	9.93	8.62	1.31	.84	.22	.14	.08	7.18	.6056	.0239	1.41	1.22	-	-	1.15	
Per cent. removed,	13	-	66	19	-	53	18	29	-	43	-	-	-	26	-	-	-	29	
Per cent. removed by trickling filter and settling tanks.	10	-	53	23	-	58	60	51	-	38	-	-	-	59	-	-	-	47	

TABLE NO. 5. — *Average Results of the Analyses of Monthly Samples of Effluent from Sand Filters.*

[Parts in 100,000.]

CITY OR TOWN.	Total Residue on Evaporation.	Free Ammonia.	Total Albuminoid Ammonia.	Chlorine.	Nitrates.	Nitrites.	Iron.
Amherst, ¹	36.85	2.06	.1198	12.18	.0250	.0052	1.533
Andover, ²	37.83	1.40	.1668	7.69	.5354	.0226	.163
Brockton (sand filters used for screened sewage), ^{2,3}	44.38	3.82	.1415	14.20	.0944	.0054	1.660
Brockton (sand filters used for settled trickling filter effluent).	42.85	1.84	.1017	13.21	.1857	.0086	.708
Clinton, ²	32.83	.51	.0847	5.23	.6970	.0129	.253
Concord, ⁴	20.60	.43	.0193	4.50	.2878	.0009	.013
Framingham, ²	40.47	1.85	.0973	9.02	.2303	.0097	2.026
Gardner (Gardner area),	35.87	1.14	.0898	6.27	1.2500	.0039	.091
Gardner (Templeton area), ²	34.11	1.82	.1888	6.69	.6978	.0178	.150
Hopedale, ²	29.21	1.86	.1703	5.70	.4090	.0120	.536
Hudson,	84.32	.92	.1006	29.87	.8354	.0067	.197
Leicester, ¹	24.40	.37	.0797	3.98	.2483	.0058	.171
Marion, ¹	22.15	.32	.0508	4.71	.5117	.0038	.053
Marlborough, ²	38.95	.45	.0418	7.84	1.1762	.0045	.019
Milford,	34.80	.87	.0751	8.45	.8558	.0093	.146
Natick,	32.57	1.16	.0814	7.74	.1991	.0179	.748
North Attleborough, ¹	18.50	.06	.0134	4.06	.3421	.0007	.008
Northbridge,	22.28	.59	.0997	4.59	.4104	.0155	.052
Norwood,	53.40	.95	.0823	19.39	.2985	.0244	.511
Pittsfield, ²	33.26	.73	.0847	4.57	.3536	.0164	.269
Southbridge, ²	30.35	2.82	.1057	7.25	.0359	.0012	2.163
Spencer,	21.78	.59	.0505	3.97	.5263	.0173	.062
Stockbridge, ^{1,2}	23.82	.13	.0505	2.66	.3075	.0087	.131
Westborough, ²	28.37	.36	.0595	5.94	.8661	.0160	.061
Worcester,	63.98	1.41	.1188	13.33	.1928	.0247	1.555

¹ Every other month.² Regular samples from two or more underdrains combined in one average.³ February, March and April omitted.⁴ February, April and June omitted.

NOTE. — Attleboro effluent omitted, as very little effluent has as yet been collected in the underdrains. Concord filters not underdrained, but purified sewage forms a spring from which the samples, represented by the above analysis, were collected.

TABLE NO. 6. — *Efficiency of Sand Filters (arranged in Order of Per Cent. of Albuminoid Ammonia removed).*

[Parts in 100,000.]

CITY OR TOWN.	FREE AMMONIA.			TOTAL ALBUMINOID AMMONIA.			CHLORINE.		Rate of Operation with Even Distribution (Gallons per Acre per Day). ¹
	Applied Sewage.	Effluent.	Per Cent. Removed.	Applied Sewage.	Effluent.	Per Cent. Removed.	Applied Sewage.	Effluent.	
Concord, ²	2.05	.43	79	.68	.0193	97	4.32	4.50	121,000
Gardner (Gardner area), ³	4.96	1.14	77	2.22	.0898	96	15.47	6.27	64,000
Marlborough, ...	4.87	.45	91	.84	.0418	95	9.41	7.84	33,000
Spencer, ...	3.64	.59	84	.95	.0505	95	5.18	3.97	48,000
Clinton, ...	3.92	.51	87	1.46	.0847	94	7.28	5.23	36,000
Framingham, ...	5.15	1.85	64	1.73	.0973	94	10.05	9.02	33,000
Westborough, ...	3.25	.36	89	.98	.0595	94	11.03	5.94	65,000
Hudson, ...	5.18	.92	82	1.36	.1006	93	29.54	29.87	34,000
North Attleborough, ...	.77	.06	92	.18	.0134	93	4.33	4.06	107,000
Milford, ...	3.48	.87	75	.82	.0751	91	9.55	8.45	47,000
Brockton (filters for screened sewage),	5.86	3.82	35	1.49	.1415	90	14.18	14.20	48,000
Pittsfield, ...	2.49	.73	71	.83	.0847	90	4.68	4.57	105,000
Worcester, ...	3.24	1.41	56	1.25	.1188	90	14.79	13.33	61,000
Natick, ...	3.53	1.16	67	.71	.0814	89	8.58	7.74	57,000
Norwood, ...	3.93	.95	76	.76	.0823	89	18.98	19.39	81,000
Amherst, ...	2.95	2.06	30	.83	.1198	86	10.99	12.18	187,000
Marion, ...	.83	.32	61	.36	.0508	86	3.40	4.71	190,000
Southbridge, ...	4.16	2.82	32	.76	.1057	86	8.32	7.25	81,000
Stockbridge, ...	1.26	.13	90	.36	.0505	86	2.16	2.66	-
Brockton (filters for settled trickling filter effluent).	3.58	1.84	49	.62	.1017	84	12.16	13.21	94,000
Northbridge, ...	2.45	.59	76	.49	.0997	80	4.74	4.59	70,000
Andover, ...	4.39	1.40	68	.81	.1668	79	8.74	7.69	75,000
Leicester, ...	1.69	.37	78	.37	.0797	78	3.97	3.98	194,000
Hopedale, ...	4.40	1.86	58	.72	.1703	76	5.83	5.70	29,000
Gardner (Templeton area), ...	3.69	1.82	51	.74	.1888	75	5.41	6.69	64,000

¹ See also Table No. 8.² See note at foot of Table No. 5.³ These filters given long periods of rest when necessary.

TABLE NO. 7.—*Filter Effluents arranged according to the Amount of Nitrates in Effluent.*

[Parts in 100,000.]

CITY OR TOWN.	NITROGEN AS		Iron in Effluent.	Total Albuminoid Ammonia in Applied Sewage.
	Nitrates in Effluent.	Nitrites in Effluent.		
Gardner (Gardner area), ...	1.2500	.0039	.091	2.22
Marlborough, ...	1.1762	.0045	.019	.84
Westborough, ...	.8661	.0160	.061	.98
Milford, ...	.8558	.0093	.146	.82
Hudson, ...	.8354	.0067	.197	1.36
Gardner (Templeton area), ...	.6978	.0178	.150	.74
Clinton, ...	.6970	.0129	.253	1.46
Andover, ...	.5354	.0226	.163	.81
Spencer, ...	.5263	.0173	.062	.95
Marion, ...	.5117	.0038	.053	.36
Northbridge, ...	.4104	.0155	.052	.49
Hopedale, ...	.4090	.0120	.536	.72
Pittsfield, ...	.3536	.0164	.269	.83
North Attleborough, ...	.3421	.0007	.008	.18
Stockbridge, ...	.3075	.0087	.131	.36
Norwood, ...	.2985	.0244	.511	.76
Concord, ...	.2878	.0009	.013	.68
Leicester, ...	.2483	.0058	.171	.37
Framingham, ...	.2303	.0097	2.026	1.73
Natick, ...	.1991	.0179	.748	.71
Worcester, ...	.1928	.0247	1.555	1.25
Brockton (sand filters used for settled trickling filter effluent).	.1857	.0086	.708	.62
Brockton (sand filters used for screened sewage).	.0944	.0054	1.660	1.49
Southbridge, ...	.0359	.0012	2.163	.76
Amherst, ...	.0250	.0052	1.533	.83

TABLE No. 8. — *Extent of Sewerage Works, Rate of Flow and Rate of Operation of Sand Filters, etc.*

CITY OR TOWN.	Popula- tion, Census of 1915.	Approxi- mate Length of Sanitary Sewers (Miles).	Approxi- mate Number of House Con- nections.	ESTIMATED QUANTITY OF SEWAGE TREATED (GALLONS PER DAY).			Estimated Average Quantity of Sewage per Connection (Gallons per Day).	Net Area of Filter Beds.	Estimated Rate of Operation with Even Dis- tribution (Gallons per Acre per Day).
				Average for Year.	Average of Month Maximum Flow.	Average for Month Minimum Flow.			
Amherst, ...	5,558	7.3	—	375,000	—	—	—	2.00	187,000
Andover, ...	7,978	11.8	704	275,000	390,000	180,000	390	3.65 ¹	75,000
Attleboro, ...	18,480	30.2	844 ²	420,000	659,000	309,000	500	15.50	27,000
Brookline, —									
Filters for screened sewage, ...	62,288	78.5	5,681	1,449,000 ³	1,601,000	1,268,000	370	30.00	48,000
Filters for settled trickling filter effluent, ...	13,192	20.3	1,450	657,000 ³	952,000	450,000	650	{	94,000
Clinton, ...				941,000 ³	1,323,000	732,000		26.23	36,000
Concord, ...	6,681	8.4	447	400,000 ³	466,000	338,000	895	3.30	121,000
Fitchburg, ...	39,656	53.1 ⁴	—	2,000,000	—	—	—	—	—
Frammingham, ...	15,860	23.5	2,164	688,000 ³	856,000	570,000	318	20.75	33,000
Gardner, ...	16,376	27.5	1,698	805,000	—	—	475	12.50 ⁵	64,000
Hopedale, ...	2,663	5.1	279	109,000 ³	151,000	78,000	390	3.79	29,000
Hudson, ...	6,758	9.1	537	305,000	425,000	245,000	568	9.00	34,000
Leicester, ...	3,322	2.6	—	70,000	—	—	—	.36	194,000
Marion, ...	1,487	—	132	125,000 ³	—	—	950	.66	190,000
Marlborough, ...	15,250	26.2	1,954	696,000	1,258,000	412,000	356	20.90	33,000
Millford, ...	13,684	17.5	1,108	437,000	561,000	316,000	394	9.30	47,000
Natick, ...	11,119	15.4	1,329	715,000 ³	1,224,000	516,000	538	12.60	57,000
North Attleborough, ...	9,398	16.3	467	750,000	—	—	1,600	7.00	107,000
Northbridge, ...	9,254	14.7	487	420,000	456,000	387,000	862	6.00	70,000
Norwood, ...	10,377	16.3	841	700,000	—	—	832	8.60	81,000
Pittsfield, ...	39,607	58.0	4,414	3,334,000 ³	3,719,000	2,252,000	755	31.78 ⁶	105,000
Southbridge, ...	14,217	15.4	—	690,000	857,000	570,000	—	8.50	81,000
Spencer, ...	5,994	11.0	—	450,000	—	—	—	9.30	48,000
Westborough, ...	5,925	9.5	543	379,000	551,000	268,000	700	5.80	65,000
Worcester, ...	162,697	175.4 ⁷	—	4,453,000 ⁸	—	—	—	72.50	61,000

¹ One sludge bed constructed in 1915 and additional filter beds under construction.² One thousand and four buildings.³ Amount pumped to filters.⁴ Includes sewers for sewage only and for sewage and surface water. (See also Table No. 4.)⁵ Gardner area, 2.50 acres. Templeton area, 10 acres.⁶ Area in use at end of year; 9.37 acres additional under construction.⁷ Includes 69.3 miles for sewage and surface water.⁸ Amount treated by sand filters only. An average of 11,900 gallons per day in addition treated by chemical precipitation.

TABLE NO. 9. — *General Features.*

[For data concerning the trickling filters at Brockton and Fitchburg see Table No. 4.]

City or Town.	Year of Construction of Additions to Works.	Depth of Underdrains (Feet).	Distance Apart of Underdrains (Feet).	Filtering Material.	Attention given to Disposal Works.
Amherst, ...	1911	4-4.5	25	Rather fine sand; found in place.	Very little attention.
Andover, ...	1898	4	20	Fair sand, small quantity of gravel; practically all handled in construction.	One man greater part of time.
Attleboro, ...	1912, 1913	4-7	35	Excellent sand and gravel; found in place, ...	One man all the time; others when necessary.
Brockton, ...	1893, 1905	5.5	30	Good sand and gravel; found in place, ...	Four men all the time; large force when necessary.
Clinton, ...	1898, 1912	8	60-70	Good sand and gravel; found in place, ...	Two men all the time; others when necessary.
Concord, ...	1899	none	-	Good sand underlaid with gravel; found in place, . .	One man once a day.
Framingham, ...	1890	-1	-	Surface material badly impregnated with organic matter; good underlying sand. Beds prepared by removal of trees and stumps and leveling where necessary.	Three or more men in summer; only one once a day in winter.
Gardner (Gardner area), ...	1891	5	20	Good sand; handled in construction, ...	One man all the time.
Gardner (Templeton area), ...	1901, 1909	3-4	20-30	Coarse sand; handled in construction, ...	One man all the time; more when necessary.
Hopedale, ...	1900	3	35-60	Some good sand and some rather fine sand, ...	One man all the time.
Hudson, ...	1904, 1910	5-6	50-100	Good sand and gravel; found in place, ...	One man all the time; others when necessary.
Leicester, ...	1894	4	8	Hard, compact sand; found in place, ...	Very little attention.
Marion, ...	1906	5	-	Mostly good sand; pockets of fine sand and some ledge; largely found in place, ...	One man every day in summer; every other day in winter.
Marlborough, ...	1891, 1908	4.5-6	30-50	Rather fine sand; found in place, ...	One man all the time; others when necessary.
Milford, ...	1909, 1910, 1911	5	40	Rather fine sand; found in place, ...	One man every day; others when necessary.
Natick, ...	1896	6	36	Sand of good quality but strata of very fine sand in places; found in place, ...	One man all the time; others when necessary.
North Attleborough, ...	1909, 1910	5-6.5	55	Coarse sand and gravel; largely found in place, . .	One man every day; others when necessary.
Northbridge, ...	1906, 1907	4	50-75	Coarse sand and gravel; found in place, ...	One man all the time; others when necessary.
Norwood, ...	1909	4-6	40	Good sand and gravel; found in place, ...	One man every day; others when necessary.
Pittsfield, ...	1901, 1915	4	35	Good sand; mostly found in place, ...	Two men all the time; others when necessary.
Southbridge, ...	1908	4	40	Fair sand and gravel; considerable quantity handled, some found in place, ...	One man once a day.
Spencer, ...	1897	- ²	-	Good sand and gravel; largely found in place, . .	One man all the time; others when necessary.
Stockbridge, ...	1899	{ 3-4.5 3-4.5	23 30	Sand filters, good quality sand, ...	One man greater part of time.
Westborough, ...	1892, 1911	5	30-40	Irrigation area, rather fine sand, ...	One man all the time; others when necessary.
Worcester, ...	1893 ³	4-6	35-50	Good sand and gravel; handled during construction, .	Several men all the time; a large force when necessary.

¹ Very little underdrainage in 8 beds. Eleven beds provided with underdrains 4 to 6 feet deep and 40 feet apart.² Only 3 beds underdrained.³ Year of first construction of sand filters. Many additions.

DIVISION OF WATER AND SEWAGE
LABORATORIES.

DIVISION OF WATER AND SEWAGE LABORATORIES.

DIRECTOR AND CHEMIST, H. W. CLARK.

Dr. ALLAN J. McLAUGHLIN, *Commissioner of Health.*

SIR: — I have the honor to present herewith the following report of the Division of Water and Sewage Laboratories for the year ending Nov. 30, 1915.

Respectfully,

H. W. CLARK,

Director and Chemist.

REPORT OF LABORATORIES AND EXPERIMENT STATION.

The Division of Water and Sewage Laboratories comprises laboratories in the State House and the experiment station and its laboratories at Lawrence. The work of the Division is carried on very largely under the provisions of the act entitled, "An Act to protect the Purity of Inland Waters of the State." Work is also called for by the provisions of many of the special acts defining the duties of the Department of Health, in regard to specific questions or matters of public welfare and public health as related to water supply, sewerage, etc. The general and special laws have to do with the public water supplies of the State, the improvement or the prevention of pollution of ponds, rivers, streams and, in fact, the condition of all the inland waters of the Commonwealth, including the bays and estuaries along the shore. Many of the special acts have to do with specific questions in regard to water, as the acquirement, development and control of watersheds, the study and improvement of certain rivers, the construction of sewers, the purification of sewage, the treatment of manufacturing wastes, etc.

At the State House laboratories chemical and microscopical examinations of water supplies from ponds, lakes, storage reservoirs, distributing reservoirs, filter galleries, tubular and driven wells, effluents from water filters, etc., are made, and also many examinations of water for new water supplies or enlargement of water systems already in existence. Examinations of rivers, polluted and otherwise, of sewage and the effluents from sewage purification plants, together with examinations of trade wastes and the effluents from filters treating these wastes, are made. Much work is also done at times in regard to the action of the water of certain towns and cities on lead and other service pipes, — this in connection with corrosion, lead poisoning, etc. Special work coming up from time to time involving various chemical analyses and experiments is carried on; for example, examination of air from sewers; examination of deposits in water pipes for the information of city and town water departments; the examination of water to show its fitness for boiler use; examination of spring waters sold to the public; examination of drinking water sup-

plied on railroad trains and in mills and factories; examination of sands from sewage filter beds in use or proposed for use in order to give the necessary information in regard to the availability, the quality or the degree of clogging of this sand by organic matter after a period of use, and laboratory investigations as to the best methods of analysis for special work.

The Lawrence Experiment Station, established by authority of the Legislature in 1887, has always been the investigating or research laboratory of the Department for nearly all questions that have to do with the treatment and purification of water, sewage, trade wastes, and many allied subjects. It is also the laboratory where up to the present time all the bacterial work of the Department in connection with these Lawrence studies is done, and also where the bacterial examinations of samples from water supplies, rivers, wells, etc., are made. At the station many sewage and trade waste filters and a few water filters are in operation at the present time, principally for the study of particular problems brought before the Department, and for illustration of methods of purification and treatment of water and sewage. Many other investigations are always under way having to do with matters, information in regard to which is required of this Department by the State.

The laboratory work, especially the analytical work at the State House laboratories, is closely allied with the work of the Engineering Division. Many of the laboratory studies and analytical results are incorporated in and appear only in the reports of the Department coming from that Division, or in the advice of the Department to cities and towns, etc. In all this work the director of the Division of Water and Sewage Laboratories is in frequent consultation with the engineer of the Department, or his principal assistants. Twenty-one special reports were made by this Division during the year to the Engineering Division on subjects connected with water purification, sewage purification, treatment of manufacturing wastes, etc.

During 1915 a more thorough and systematic bacterial study of many of the principal water supplies of the State was made than in previous years, and tables presenting the results of these studies are given in this report.

At the Lawrence Experiment Station 50 filters and other devices for the treatment of water, sewage, etc., were maintained in operation during the year, and special studies, the brief details of which are given in a subsequent portion of this report, were made upon the following subjects:—

1. Studies in regard to sewage sludge and its disposal in a new form of stabilizing tank.

2. Studies in regard to available nitrogen in sludge, and processes for increasing its availability for commercial purposes.

3. Studies of the factors controlling the putrescibility of river deposits, especially the influence of the ratio of carbon to nitrogen.

4. Studies of the purification of sewage by aeration and growths, both by slate colloiders and by the activated sludge process.

5. Studies of the greater rate efficiency of deep trickling filters compared with shallow filters, and the cause of this efficiency.

6. Studies in regard to the purification of the waste liquors from paper mills, tanneries, leatherboard mills, wool-washing establishments, cloth-bleaching processes, etc.

7. Studies of shellfish pollution.

8. Studies of water sterilization by ultra violet rays.

9. Studies of sterilization of water by liquid chlorine.

10. Studies of improvement of water by the removal of iron, etc.

In carrying out the analytical work of this Division made necessary by the samples forwarded to this laboratory by the Engineering Division, and for the studies enumerated here and various other minor studies called for by the work of the Department, the following amount of analytical work was done:—

Laboratory, Room 540, State House.

Chemical examinations of water, sewage, wastes, etc., ...	7,250
Microscopical examinations of water, ...	2,438
Special examinations for lead and manganese, ...	198
Special examinations (field work) for carbonic acid, dissolved oxygen, alkalinity, turbidity and color, ...	268
Examinations of fats, arsenic, zinc and other miscellaneous examinations, ...	563
	———— 10,717

Lawrence Experiment Station.

Chemical examinations of water, sewage, ice and manufactural wastes, ...	3,090
Chemical examinations of sand, ...	85
Mechanical examinations of sand, ...	75
Bacterial examinations of water, sewage, ice, manufactural wastes and sand, ...	4,559
Bacterial examinations of shellfish, ...	135
	———— 7,944
	18,661

As stated previously, many bacterial analyses of certain water supplies were made during the year, and a summary of the work is given in the following table:—

Results of Bacterial Examinations of Water Supplies of Cities.

CITIES.	Num- ber of Sam- ples.	AVERAGE NUMBER OF BACTERIA PER CUBIC CENTIMETER.			PER CENT. OF SAMPLES IN WHICH B. COLI WERE FOUND IN—			
		4 Days, 20° C.	24 HOURS, 37° C.		0.1 Cubic Centi- meter.	1.0 Cubic Centi- meter.	10 Cubic Centi- meters.	100 Cubic Centi- meters.
			Total.	Red.				
ATTLEBORO, ...	3	8	0	0	0	0	0	33
BOSTON (Metropolitan):—								
City proper, ...	36	82	20	1.9	0	0	8	31
Stoneham, Spot Pond, ...	27	162	6	1.0	0	0	4	26
North Suburban, ...	102	104	9	1.0	0	0	1 ¹	16 ¹
South Suburban, ...	28	85	17	0.8	0	0	0	11 ¹
BROCKTON (including Whitman), ...	11	112	1	0.9	0	0	0	9
CAMBRIDGE:—								
Fresh Pond, intake, ...	13	89	20	2.0	0	0	0	46
Taps in city, ...	29	182	26	0.5	3	3	10	47
CHICOPEE, ...	3	123	8	1	0	0	33	100
FALL RIVER:—								
Cress Brook, ...	5	3,960	70	0	0	0	40	100
Highland Brook, ...	9	918	83	7.4	11	11	56	78
Terry Brook, ...	7	421	14	1.4	14	14	58	86
Five other inlets to Watuppa Lake, ...	5	80	9	4	0	20	60	100
Watuppa Lake, intake, ...	21	80	5	0.2	0	0	14	62
FITCHBURG:—								
Reservoirs and taps, ...	7	137	5	1.4	0	0	14	29
GLOUCESTER, ...	10	119	10	5.6	0	0	0	10
HAVERTHILL (including Bradford), ...	13	96	7	1.4	8	0	54 ⁸	54
HOLYOKE, ...	3	35	5	0.3	0	0	0	33
LAWRENCE, ...	355	50	8	1.7	0	3 ⁰	28	70
LYNN, ...	5	160	4	0.6	0	20	20	60
MARLBOROUGH, ...	5	35	2	0	0	0	20	40
NEW BEDFORD, ...	22	31	2	0	0	0	18 ⁵	23
NEWBURYPORT, ...	6	71	9	1.0	0	0	0	33
NEWTON, ...	4	33	3	0	0	0	0	25 ¹
NORTHAMPTON, ...	3	36	7	0.7	0	0	0	0
SALEM:—								
Ipswich River at Topsfield, ...	14	458	68	9	19	56	100 ⁶	100
Wenham Lake, upper end and inlets, ...	19	832	45	6.0	0	25	45 ⁵	65 ⁵
Wenham Lake, P. S. tap, ...	14	81	10	0.6	0	0	13	68
City taps, ...	12	64	11	0.4	7	7	36	57
SPRINGFIELD, ...	2	24	1	0	0	0	0	0
TAUNTON, ...	5	48	1	0	0	0	20	20
WALTHAM, ...	5	6	1	0	0	0	0	20
WOBURN, ...	4	9	0	0	0	0	0	0
WORCESTER, ...	14	248	10	0.4	0	0	7	50

¹ Per cent. of samples in which sewage streptococcus was found.

Results of Bacterial Examinations of Water Supplies of Towns.

TOWNS.	Number of Samples.	AVERAGE NUMBER OF BACTERIA PER CUBIC CENTIMETER.			PER CENT. OF SAMPLES IN WHICH B. COLI WERE FOUND IN—			
		4 Days, 20° C.	24 HOURS, 37° C.		0.1 Cubic Centimeter.	1.0 Cubic Centimeter.	10 Cubic Centimeters.	100 Cubic Centimeters.
			Total.	Red.				
Abington (including Rockland), .	6	12	2	0	0	0	0	17
Adams, ...	8	89	23	25	0	25	{ 100 25 ¹	100 13 ¹
Amesbury, ...	4	8	0	0	0	0	0	0
Athol, ...	3	290	20	0	0	0	0	33
Braintree, ...	6	536	6	0.5	0	0	{ 17 17 ¹	100
Bridgewater, ...	3	8	3	0	0	0	0	0
Brookline, ...	4	8	2	0	0	25	25	{ 50 25 ¹
Clinton, ...	3	53	17	2.3	0	0	33	100
Concord, ...	4	12	1	0	0	0	0	50
Danvers, ...	4	262	10	0.8	0	50	75	100
Dedham, ...	4	5	2	0	0	0	0	50
Framingham, ...	3	25	2	0	0	0	{ 33 33 ¹	33
Gardner, ...	4	229	1	0	0	0	0	0
Hudson, ...	3	16	1	0	0	0	0	67
Ipswich, ...	4	41	29	13	0	0	0	50
Marion, ...	5	24	1	0	0	0	80	100
Maynard, ...	4	103	4	1	0	0	0	25
Middleborough, ...	3	1	2	0	0	0	0	0
Milford, ...	4	76	2	0.3	0	0	{ 50 25 ¹	75
Natick, ...	4	5	0	0	0	0	0	25
North Attleborough, ...	3	0	0	0	0	0	0	0
Northbridge (Whitinsville), ...	4	161	27	7	0	0	75	100
Norwood, ...	4	24	1	0	0	0	25	100
Peabody, ...	4	142	8	2	0	0	50	75
Plymouth, ...	3	59	28	14	0	0	0	0
Reading, ...	3	8	3	0	0	0	0	0
Salisbury, ...	6	12	1	0	0	0	17	67
Southbridge, ...	4	52	5	0.8	0	0	25	75
Stoughton, ...	3	31	2	0.3	0	0	67	{ 100 67 ¹
Wakefield:—								
Crystal Lake, intake, ...	14	77	31	5.7	0	0	14	{ 29 7 ¹
Tap in P. S. and town taps, ...	52	49	23	2	0	0	0	0

¹ Per cent. of samples in which sewage streptococcus was found.

Results of Bacterial Examinations of Water Supplies of Towns — Concluded.

TOWNS.	Num- ber of Sam- ples.	AVERAGE NUMBER OF BACTERIA PER CUBIC CENTIMETER.			PER CENT. OF SAMPLES IN WHICH B. COLI WERE FOUND IN —			
		4 Days, 20° C.	24 HOURS, 37° C.		0.1 Cubic Centi- meter.	1.0 Cubic Centi- meter.	10 Cubic Centi- meters.	100 Cubic Centi- meters.
			Total.	Red.				
Webster, ...	4	12	1	0	0	0	0	0
Weymouth, ...	4	96	25	3	25	0	0	25
Winchendon, ...	4	7	1	0	0	0	25	50
Winchester, ...	4	40	0	0	0	0	0	50

EXPERIMENTS UPON THE PURIFICATION OF SEWAGE AND WATER AT THE LAWRENCE EXPERIMENT STATION DURING THE YEAR 1915.

CHARACTER OF THE SEWAGE USED IN THE EXPERIMENTS.

The sewage used in former years at the station was pumped from the Lawrence Street sewer through a 2½-inch pipe about 4,400 feet long. For much of this distance the pipe is laid in the bed of the Merrimack River, and sections of the pipe have been replaced from time to time as it has become weakened from corrosion.

Early in the summer of 1915 a considerable amount of leakage of river water into the pipe began, and gradually increased. An unusually high river during the summer months made it impossible to repair the pipe, and, indeed, it was evident that it was a case of renewing and relaying the entire pipe line if sewage was still to be obtained from the Lawrence Street sewer. It seemed on the whole more advisable to extend the old pipe from the point at which it enters the river to the Osgood Street sewer, so called, on the opposite bank of the river.

This sewer has been built since the station was established, and drains a less densely populated section than the Lawrence Street sewer. By September 13 the extension was completed, the pipe being extended about 100 feet into the sewer beyond the connection from the mill, located directly over the outlet. The sewage is at present considerably weaker than the old supply and reaches the station in a fresher condition, the pipe through which it is pumped being only about one-third as long as the old pipe.

"Regular station sewage" is the average of samples collected four times each day of the sewage as it reaches the experiment station; "settled station sewage" is the same sewage settled for at least two hours in a cylindrical tank; "sewage applied to Filters Nos. 1, 6 and 9A" is the average of daily samples of all the sewage applied to the large intermittent filters situated out of doors.

The average analyses of the various representative samples of sewage collected during the year are shown in the following table:—

*Average Analyses.**Regular Station Sewage from Dec. 1, 1914, to Sept. 13, 1915.*

[Parts in 100,000.]

AMMONIA.			KJELDAHL NITROGEN.		Chlorine.	Oxygen consumed.	Bacteria per Cubic Centimeter.
Free.	ALBUMINOID.						
	Total.	In Solution.	Total.	In Solution.			
2.86	.42	.22	.97	.48	8.44	3.30	2,563,000

Regular Station Sewage from Sept. 13, to Dec. 1, 1915.

2.11	.38	.23	.96	.57	4.73	3.03	1,669,000
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Sewage applied to Filters Nos. 1, 6 and 9A.

2.43	.36	—	.83	—	6.84	3.03	—
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*Average Solids.**Regular Station Sewage.*

[Parts in 100,000.]

UNFILTERED.			FILTERED.			In SUSPENSION.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
46.1	20.2	25.9	35.8	12.4	23.4	10.3	7.8	2.5

PRELIMINARY TREATMENTS FOR THE CLARIFICATION OF SEWAGE.

Comparative studies of the clarification of sewage by sedimentation, by sedimentation preceded by aeration in slate tanks, by straining through coal and by chemical precipitation have been continued during 1915.

Sedimentation in Open Tanks.

All the sewage applied to the filters in the filter house, amounting to about 1,000 gallons a day, is clarified by at least two hours' settling in a cylindrical tank with a bottom sloping at an angle of 60° and from which sludge is drawn at least twice a week. The average weight of

dry suspended matter per million gallons removed by this tank from the sewage pumped from the Lawrence Street sewer was 592 pounds, and from the Osgood Street sewer, 472 pounds; that is, the per cent. of suspended solids removed from the former was 61.2, and from the latter, 44.9.

Precipitation with Sulphate of Alumina.

Throughout the year sewage was treated daily with from 3.5 to 7 grains per gallon of sulphate of alumina. After four hours' settling the clarified sewage was drawn from the sludge to be applied to trickling Filter No. 457 and sand Filter No. 432. The average removal of suspended solids was 54.4 per cent.

Straining through Anthracite Coal.

Strainer E, containing 12 inches in depth of buckwheat coal and first put into operation in 1901, was operated at a rate of 1,000,000 gallons per acre daily throughout the year. The surface of the strainer was raked four times to relieve clogging, and finally on November 26 an inch of sludge was removed and the upper 3 inches of coal removed, washed and replaced. The average removal of suspended solids was 62.1 per cent.

Average Analyses.

Settled Station Sewage.

[Parts in 100,000.]

AMMONIA.			KJELDAHL NITROGEN.		Chlorine.	Oxygen consumed.	Bacteria per Cubic Centimeter.
Free.	ALBUMINOID.						
	Total.	In Solution.	Total.	In Solution.			
2.18	.25	.17	.58	.38	6.43	2.18	1,253,000

Sewage precipitated with Sulphate of Alumina.

3.05	.27	.17	.60	.35	7.75	1.81	582,000
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Effluent from Strainer E.

2.45	.23	.16	.56	.35	6.79	1.93	506,000
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*Average Solids.**Settled Station Sewage.*

[Parts in 100,000.]

UNFILTERED.			FILTERED.			IN SUSPENSION.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
39.0	15.2	23.8	34.6	12.0	22.6	4.4	3.2	1.2

Sewage precipitated with Sulphate of Alumina.

36.6	12.4	24.2	31.9	9.2	22.7	4.7	3.2	1.5
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Effluent from Strainer E.

32.5	11.0	21.5	28.6	8.3	20.3	3.9	2.7	1.2
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STUDIES OF SLUDGE.

Fertilizing Value. — The utilization of sewage sludge for fertilizer purposes was one of the earliest problems of sewage disposal. Up to the present time, with few exceptions, however, sludge has been considered without commercial value on account of the large proportion of fats and water present. In several places in England processes have been installed to remove part of the fats, and the sludge is then sold and used as a fertilizer. Any process that concentrates the sludge or increases the relative percentage of nitrogen present, increases its value. The activated sludge process is of considerable promise in this latter respect.

Available Nitrogen. — The only satisfactory test of the value of a fertilizer is its use in actual practice. There are a number of laboratory tests which are claimed to give results comparable with actual tests, and one of these (described by Jones in the *Journal of Industrial and Engineering Chemistry*, 4, 438) was used on a number of sludges at the Lawrence Experiment Station. The process consists in digesting a sample containing about .05 of a gram of organic nitrogen in a flask containing 15 glass beads, 20 cubic centimeters of water and 100 cubic centimeters of alkaline permanganate (25 g KMnO_4 and 150 g NaOH per liter). The flask is connected with a condenser, to the outlet of which a receiver containing standard acid has been attached.

The digestion is continued thirty minutes at a temperature just below the distillation point, and then 95 cubic centimeters are distilled off, the whole procedure taking ninety minutes. The organic nitrogen converted to ammonia by this process is considered available for plant growths. This process does not, however, show what effect the fats would have in actual practice.

Five samples of sludge from Lawrence sewage, containing on an average 2.88 per cent. N, when tested by this method gave percentages of available nitrogen or availabilities of from 40 to 71 per cent. with an average of 58 per cent. Press cake from a wool-degreasing plant gave 37 per cent. of available nitrogen, which is about that found for peat. Peat is known to have little direct fertilizing value, in spite of the fact that it may contain over 3 per cent. of nitrogen. At the other extreme, dried meat scraps had an availability of 89 per cent. A sample of light, unmanured loam gave an availability of 68 per cent. Jones gives availabilities slightly below 65 per cent. for the organic nitrogen of medium grade tankage, cottonseed meal and commercial fertilizer. From these results it would seem that if the fats which run from 20 to 25 per cent. in this Lawrence sludge were removed, the organic nitrogen would be as valuable as much of the organic nitrogen used in fertilizers.

Available Nitrogen in Trickling Filter Sediment. — The organic nitrogen of the sediment from trickling filters gave an availability of 68 per cent. This sediment contained 3.73 per cent. of nitrogen and less than 1 per cent. of fats, and should be much more valuable than the sewage sludge. Besides the nitrogen, sewage sludge contains from 1 to 3 per cent. of P_2O_5 .

Effect of Age. — To determine what effect aging sludge has on availability, fats, etc., 12 gallon bottles were filled with sludge containing 1 per cent. of solid matter and the contents of one bottle were analyzed each month. As usually happens in a series of this sort, there were occasional irregularities in the results. There was little difference in the analyses after the sixth month and little change in the availability, there being an increase from 55 per cent. at the start to 60 per cent. The fats dropped from 27.4 per cent. at the start to 7 per cent. The changes in the per cent. of nitrogen in the sludge were the most irregular, decreasing from 4.21 per cent. to below 3 per cent. The per cent. loss on ignition decreased from 70 per cent. at the start to around 50 per cent. At no time was there any great increase in the organic matter in solution, showing that the nitrogen and organic matter lost must have disappeared as gas.

These results indicate that only slight improvement in the fertilizer

value of sludge results from the simple aging of sludge in contact with sewage. Similar results, extending over a shorter period, were obtained from sludge which had been drained of as much moisture as possible. Probably none of these sludges went through the biological changes that occur in Imhoff or similar tanks, as they were all putrescent after several months.

Processing. — The most promising way of utilizing sewage sludge is by one of the processing methods. In the “wet-mixed” process base goods, consisting of any dry nitrogenous trade wastes, are mixed in a closed chamber with rock phosphate and the requisite amount of sulphuric acid to make acid phosphate and allowed to stand several days until cool. Under these conditions more or less hydrolysis takes place and the inert organic matter is broken up into a variety of simpler compounds, many of which are utilized directly by plants or are readily converted by soil bacteria to plant food. The only difficulty in such use of sludge would be the cost of drying and removing fats.

Hydrolysis. — Much work has been done by agricultural and physiological chemists on the hydrolysis of proteid bodies. It was thought that by applying their methods to the nitrogenous bodies in sludge some information might be obtained as to the nature of the changes taking place when a sludge becomes non-putrescible, and as to why this change takes place more readily in some sludges than in others. The method of Van Slyke¹ was followed. The time required for the work upon each sample is so considerable that not enough analyses were made to show satisfactory, definite results in this respect. Lathrop's² results show that hydrolysis in the “wet-mixed” process mentioned above is nearly as complete as in the Van Slyke laboratory process, so that the results at Lawrence show roughly at least what would have occurred in actual practice if the “wet-mixed” process were applied to sludge.

The following table, showing representative results of analyses made at Lawrence, gives the per cent. of the total nitrogen appearing in the various organic compounds after ten hours' hydrolysis with boiling hydrochloric acid. These analyses show that an increase in available nitrogen can be obtained from sewage sludge, the same as from “base” goods, by the wet process.

¹ Journal Biological Chemistry, 10, 15-55.

² United States Department of Agriculture, Bulletin 158, p. 15.

Per Cent. of Total Nitrogen.

	Lawrence Sludge.	Andover Sludge.	Brockton Sludge.	Degreasing Press Cake.
Form of nitrogen: —				
Insoluble, ...	6.1	5.8	14.0	6.1
Amide, ...	13.7	3.9	9.5	13.2
Humin, ...	3.3	1.3	5.3	5.9
Diamino acid fraction: —				
Arginine, ...	7.9	18.3	8.5	10.3
Histidine, ...	16.7	0.0	7.9	6.4
Lysine, ...	2.3	7.8	3.0	1.3
Monoamino acid fraction: —				
Amino, ...	48.6	57.9	38.0	48.7
Nonamino, ...	3.8	6.3	14.3	5.4
Per cent. availability of nitrogen by alkaline permanganate test.	50.0	43.0	38.0	37.0

STABILIZING SLUDGE BY OXIDATION.

All the processes of digesting sludge to render it less offensive and more easy to handle — from the septic to the Imhoff tank — are carried on under anaerobic conditions. In experiments to hasten the stabilizing of sludge in an activated sludge tank the addition of nitrates was found to be so efficient that it was decided to continue experiments along this line. During June sludge, amounting to 21.5 gallons and containing 95 per cent. of water, was placed in one compartment of a galvanized iron tank (No. 470), $2\frac{1}{2}$ feet deep, $2\frac{1}{2}$ feet wide and 4 feet 2 inches long. This tank was divided into two nearly equal compartments by a wooden partition with openings 18 inches above the bottom of the tank. From 20 to 30 gallons of well-nitrified effluent from a sand sewage filter were passed into the tank daily. During the first few weeks active but inoffensive methane fermentation occurred and a scum tended to form at the surface which it was necessary to break in order to allow intimate contact between the sludge and effluent. It is probable that during this period insufficient nitrate oxygen was present. The sludge, however, became dense and inoffensive.

During September and October 48 gallons of sludge containing 5 per cent. of solids was again run into the tank. Sand filter effluents were added as before until December, when the tank was again emptied. The sludge at this time was inoffensive. The overflow from the tank was at times somewhat turbid but generally clear and always inoffensive. Whenever a well-nitrified effluent is available, this method offers a means of rendering sludge inoffensive without expensive deep tanks.

For convenience in expressing results, the sludges have been calculated to volumes of sludge containing 5 per cent. solids, and the filter effluents to a basis of 2.0 parts in 100,000 of nitrates. On this basis, during the first three months of operation, one volume of effluent was added daily for each volume of sludge. During the second three months only 0.61 volume of effluent was added for each volume of sludge.

Average analyses are shown in the following tables, and the great destruction in the tank of matters determined as "loss on ignition," and of fatty matters, will be noted: —

Average Sand Filter Effluents applied to Tank No. 470.

[Parts in 100,000.]

DATE.	AMMONIA.		Nitrogen as Nitrates.
	Free.	Albuminoid.	
1915.			
June 1 to August 31, inclusive, ...	.0521	.0166	2.00
September 1 to November 30, inclusive, ...	.0696	.0141	2.00

Average Overflow of Tank No. 470.

June 1 to August 31, inclusive, ...	1.20	.1200	0.21
September 1 to November 30, inclusive, ...	0.71	.1200	0.14

Analyses of Sludge on a Dry Basis, Sludge added to Tank No. 470.

DATE.	PER CENT.		
	Loss on Ignition.	Kjeldahl Nitrogen.	Fats.
1915.			
June, ...	66.4	2.27	28.7
September and October, ...	70.0	3.80	30.9

Sludge drawn from Tank No. 470.

September, ...	44.9	1.23	5.5
December, ...	31.0	2.01	19.0

CARBON MONOXIDE IN GASES FROM FERMENTING SEWAGE SLUDGES.

A number of deaths from inhaling carbon monoxide in sewers having recently occurred in Massachusetts, it was thought desirable to determine the volume of carbon monoxide in the gases coming from fermenting sewage sludge such as might collect in such sewers. Samples of station sludge were collected in carboys and allowed to stand until fermentation took place, when 4-liter samples of gas were collected for analysis. Analyses in previous years showed that these gases consisted of from 50 to 75 per cent. methane, the remainder being nitrogen and carbon dioxide.

The method of analysis employed at this time was that used by Kinnicut¹ and others, and consists in passing the gas through fuming sulphuric acid, then through a tube containing lumps of caustic soda and then a U-tube containing iodine pentoxide heated to 150° C. in an oil bath. The iodine set free is titrated, and from the amount of iodine the carbon monoxide is calculated. Kinnicut and Seidell² used this method for small amounts of carbon monoxide, largely diluted with air and containing only small amounts of hydrocarbons. In the Lawrence work the carbon monoxide was diluted largely with methane and possibly other hydrocarbons. Methane is not supposed to be oxidized by the iodine pentoxide, and unsaturated hydrocarbons are supposed to be absorbed by fuming sulphuric acid.

The results obtained must be considered as representing the maximum amount of carbon monoxide present, and are subject to an uncertain correction. The first lot of sludge stood from April 24 to June 23, and 10 4-liter samples of evolved gas were collected and analyzed. The maximum carbon monoxide value found was .009 per cent., and the average .005 per cent. The second lot of sludge stood from June 23 to August 13, and 23 4-liter samples of gas were analyzed. The maximum carbon monoxide found was 0.19 per cent., and the average 0.132 per cent. The third lot of sludge stood from August 20 to October 8, and 15 4-liter samples were analyzed. The maximum carbon monoxide found in the gas was 0.14 per cent., and the average was 0.098 per cent.

These results indicate that it is extremely unlikely that dangerous amounts of carbon monoxide are formed from fermenting sewage sludge.

¹ Journal of American Chemical Society, 22 (1900), 14.

² Journal of Industrial and Engineering Chemistry, 6, 321.

RELATION BETWEEN THE C/N RATIO IN MUDS OR DEPOSITS, AND
THE PRODUCTION OF OFFENSIVE ODORS UNDER MORE OR LESS
ANAEROBIC CONDITIONS.

While determining the oxygen absorptive powers of certain samples of mud from river beds, etc., it was noticed that some developed offensive odors and others did not even when they absorbed approximately the same amount of dissolved oxygen. To study the reason for this, the following study was made: From 1 to 4 inches of mud of known composition was placed in gallon bottles filled with water and closed with rubber stoppers fitted with two glass tubes, one reaching nearly to the bottom and the other just through the stopper. Aerated tap water was introduced through the longer tube and portions withdrawn through the shorter tube for examination. The conditions in the mud were thus kept anaerobic, while fresh water was introduced often enough to keep a small amount of dissolved oxygen in the supernatant water, imitating conditions in the beds of ponds and streams. Dissolved oxygen and odors were determined daily.

In the following table of results it will be noticed that when the C/N ratio was low, offensive odors were formed, even though the actual amount of nitrogen was lower than in a sample that did not produce offensive odors, and it was very evident that the kind of changeable organic matter and not the amount determines whether or not a deposit will be offensive. It appears also that the ratio between C and N will give an indication of the result. In this experiment the muds having the largest amount of fats and the lowest C/N ratio were the ones giving the most offensive odors.

SAMPLE FROM —	PER CENT.				C/N Ratio.	Odor.
	Loss on Ignition.	Carbon.	Nitro- gen.	Fats.		
Merrimack River, .	10.5	4.20	.500	1.08	8.4	Offensive.
Salt water flat, . .	5.0	2.00	.120	—	17.0	Vegetable, not offensive.
Merrimack River, .	7.8	3.12	.240	0.17	13.0	Slightly offensive.
Polluted pond, . .	5.0	2.00	.190	0.27	10.5	Offensive.
Storage reservoir, .	15.0	6.00	.370	—	16.2	Vegetable, not offensive.

PURIFICATION OF SEWAGE BY AERATION WITH THE AID OF BIOLOGICAL GROWTHS.

In 1911 and 1912 studies were made at Lawrence in regard to the life of fish in polluted waters, and in water containing in some cases much, and in others little, dissolved oxygen. In the course of this investigation many interesting data were obtained in regard to the part that growths of algæ, largely *Protococcus*, *Scenedesmus* and *Monas*, played in the consumption of CO_2 and the liberation of oxygen. Weak sewage in sealed bottles was found to be partially purified when these organisms were present. Further, forced aeration and the presence of growths gave remarkable purification results in these bottle experiments (Report of Massachusetts State Board of Health, 1912, pp. 344, 345).

Immediately following this work, that is, in April, 1912, three and one-half years ago, quite extensive experiments were begun in regard to the purification of sewage by aeration aided by bacterial and microscopic growths. This work was for a month or two carried on in gallon bottles and carboys, and we found that by twenty-four hours' aeration we could obtain a sewage or bottle effluent which was stable and contained at times nitrates equal to 1.5 parts in 100,000 (Report of Massachusetts State Board of Health for 1912, p. 291). This was the first recorded successful work and method of purifying sewage *in volume*; that is, without the aid of filtering media. This was the work shown to Dr. Fowler of Manchester, Eng., in August, 1912, and which he mentions in his discussion of Ardern and Lockett's paper (Journal of Society of Chemical Industry, May 30, 1914). His statement as applied to Ardern and Lockett's activated sludge work, so called, is as follows: —

It is only right to admit that the work was really due to a visit to the experiment station at Lawrence, Mass., where I (Fowler) saw sewage which had been completely purified by twenty-four hours' aeration.

In our work with gallon bottles the sewage was emptied from them daily, leaving only the growths on the sides and bottoms of the bottles, these growths and the sides of the bottles being also, of course, covered with a sewage slime. Fowler's first experiments were almost identical with this Lawrence work. Following our first work, a tank containing a few layers of slate was put into operation late in 1912. Growths, brown and gray in color (Massachusetts State Board of Health Report for 1912, p. 292), soon covered these slate layers, and sewage slime was also prominent. These growths, aided by aeration

and the circulation of the sewage in the tank caused by the air currents, collected not only suspended matters, but also a large percentage of the colloidal matters of the sewage; bacterial oxidation occurred, and again as with the bottle experiments, stable and well-clarified effluents were obtained by twenty-four hours' treatment in this tank. To sum up the work so far, then, it is plain that many investigators at home and abroad, including Drown, Dupre and Dibdin, Mason and Hine, Black and Phelps, Fowler and others, had sought to purify sewage by direct chemical oxidation by air currents and had failed. At Lawrence, however, we discovered the efficiency of growths in aiding the purification of sewage by aeration and changed the current of investigation along this line of work. The work up to Dec. 1, 1914, has been given in previous reports.

Aerating Tank No. 449, started in January, 1913, was continued without change throughout 1915. Tanks Nos. 458 and 459, started April 13, 1914, were continued as last year up to March 16, 1915, when enough of the slates were removed to make the area of slate per gallon of sewage one-half and one-fourth, respectively, that of Tank No. 449. All 3 tanks were now operated with regular sewage. The square feet of slate surface per gallon of sewage treated was from this date as follows: Tank No. 449, 1.09 square feet; Tank No. 458, .55 square feet; and Tank No. 459, .27 square feet. On October 6 the period of aeration was increased from five to six hours, and throughout the year the volume of air applied was maintained at 50,000 cubic feet per hour per million gallons of sewage on a basis of a working depth of 5 feet of sewage.

As far as can be judged from the work during the year, the effluent from a slate aerating tank will be of practically the same quality whether the sewage treated is fresh or septic. The removal from the sewage of suspended solids by the tanks with the smaller amounts of slate was slightly better than by Tank No. 449, while the removal of colloids, as shown by reduction of Kjeldahl nitrogen remaining after filtration through filter paper, was about the same. Practically none of the effluents from these 3 aerating tanks were absolutely stable.

The method of operation of secondary aerating Tank No. 449B, receiving the effluent from aerating Tank No. 449, was changed a number of times during the year. During the last two months of the year the period of aeration was eight hours. Nitrification was fairly good during this period and about 90 per cent. of the samples were stable.

The following tables show the reduction of organic matter, matters in suspension and colloidal matter by these tanks:—

*Average Analyses.**Regular Station Sewage applied to Aerating Tank No. 449.*

[Parts in 100,000.]

AMMONIA.			KJELDAHL NITROGEN.		Chlo- rine.	NITROGEN AS—		Oxygen con- sumed.	Bacteria per Cubic Cen- timeter.
Free.	ALBUMINOID.					Ni- trates.	Ni- trites.		
	Total.	In So- lution.	Total.	In So- lution.					
3.07	.46	.30	1.03	.63	8.50	—	—	3.25	2,563,400

Effluent from Aerating Tank No. 449.

2.69	.25	.18	0.49	.37	7.70	.000	.0013	1.62	1,196,000
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Effluent from Aerating Tank No. 449B after Eight Hours' Aeration.

2.86	.11	—	—	—	4.40	.030	.0007	1.17	—
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Settled Station Sewage applied to Aerating Tank No. 458, Dec. 1, 1914, to March 15, 1915.

3.45	.42	.27	0.95	.57	7.09	—	—	2.96	1,466,000
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Effluent from Aerating Tank No. 458, Dec. 1, 1914, to March 15, 1915.

3.07	.24	.18	0.53	.35	9.00	.000	.0003	1.86	915,000
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Regular Station Sewage applied to Aerating Tanks Nos. 458 and 459, March 15 to Dec. 1, 1915.

2.80	.42	.27	0.95	.57	7.09	—	—	2.96	2,563,000
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Effluent from Aerating Tank No. 458, March 15 to Dec. 1, 1915.

2.00	.17	.14	0.40	.26	6.30	.000	.0013	1.46	1,202,000
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Regular Station Sewage applied to Septic Tank No. 459, Dec. 1, 1914, to March 15, 1915.

3.28	.55	.35	1.13	.69	10.30	—	—	4.49	2,563,000
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Septic Sewage applied to Aerating Tank No. 459, Dec. 1, 1914, to March 15, 1915.

3.25	.31	.25	0.58	.45	9.80	—	—	2.41	1,580,000
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Effluent from Aerating Tank No. 459, Dec. 1, 1914, to March 15, 1915.

3.20	.26	.21	0.48	.38	9.40	.000	.0002	1.97	807,000
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Effluent from Aerating Tank No. 459, March 15 to Dec. 1, 1915.

1.96	.19	—	0.44	.36	6.70	.000	.0006	1.61	1,202,000
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*Average Solids.**Regular Station Sewage applied to Aerating Tank No. 449.*

[Parts in 100,000.]

UNFILTERED.			FILTERED.			IN SUSPENSION.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
46.8	21.6	25.2	35.8	13.6	22.2	11.0	8.0	3.0

Effluent from Aerating Tank No. 449.

34.8	10.9	23.9	29.6	9.7	19.9	5.2	1.2	4.0
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Settled Station Sewage applied to Aerating Tank No. 458, Dec. 1, 1914, to March 15, 1915.

41.1	15.9	25.2	37.8	13.7	24.1	3.3	2.2	1.1
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Effluent from Aerating Tank No. 458, Dec. 1, 1914, to March 15, 1915.

36.6	12.2	24.4	34.2	10.6	23.6	2.4	1.6	0.8
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Regular Station Sewage applied to Aerating Tanks Nos. 458 and 459, March 15, 1915, to Dec. 1, 1915.

46.1	20.7	25.4	34.4	11.2	23.2	11.7	9.5	2.2
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Effluent from Aerating Tank No. 458, March 15 to Dec. 1, 1915.

25.0	8.1	16.9	23.8	7.6	16.2	1.2	0.5	0.7
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Regular Station Sewage applied to Septic Tank No. 459, Dec. 1, 1914, to March 15, 1915.

59.4	27.8	31.6	44.0	16.5	27.5	15.4	11.3	4.1
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Septic Sewage applied to Aerating Tank No. 459, Dec. 1, 1914, to March 15, 1915.

41.7	15.9	25.8	37.1	13.5	23.6	4.6	2.4	2.2
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Effluent from Aerating Tank No. 459, Dec. 1, 1914, to March 15, 1915.

36.4	12.4	24.0	34.5	10.9	23.6	1.9	1.5	0.4
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Effluent from Aerating Tank No. 459, March 15 to Dec. 1, 1915.

28.6	9.2	19.4	26.0	7.1	18.9	2.6	2.1	0.5
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An activated sludge tank, so called, No. 465, was put into operation on February 15. This tank is 26 inches in diameter, 4 feet deep, with a conical bottom, and has a capacity of 110 gallons, exclusive of the cone. Air is applied at the point of the cone, insuring a good circulation of the sludge. During the first month sludge from trickling filters, a sewage settling tank and some deposits from the slate tanks were placed in this tank until it was about one-fifth full of concentrated sludge. As the air supply was then arranged, air was not available during the night, hence the dissolved oxygen became exhausted, and more or less septic action set in during the night. It was undoubtedly a mistake to add the sludge more rapidly than it could be rendered stable by the tank. After a month's aeration there was little improvement, the sludge being still foul-smelling and not settling readily.

On September 13 a continuous supply of air became available, and average samples were collected for analysis at the end of five hours' and twenty-four hours' aeration. Beginning October 6 samples were collected after three and eight hours' aeration, and the sludge was continuously aerated to maintain aerobic conditions. Eighty-eight per cent. of the samples after three hours' aeration and settling and all samples after longer aeration were stable on incubation. The heavy part of the activated sludge settles readily in a few minutes, but the finer, light-colored matter settles more slowly and sedimentation is not complete in one hour. The longer the time of aeration the more readily the fine matter settles. During the latter part of the year, however, the tank was in good operation, and a clear, nearly odorless effluent containing some nitrates was invariably obtained.

Analyses are shown in the following tables:—

Average Analyses.

Effluent from Activated Sludge Tank No. 465 after Three Hours' Aeration and One Hour Settling, Sept. 13 to Oct. 5, 1915.

[Parts in 100,000.]

TURBIDITY.	AMMONIA.			KJELDAHL NITROGEN.		Chlo- rine.	NITROGEN AS —		Oxygen con- sumed.
	Free.	ALBUMINOID.		Total.	In So- lution.		Ni- trates.	Ni- trites.	
		Total.	In So- lution.						
Slight,	1.45	.15	.11	.40	.29	4.20	.100	.0014	1.13

Effluent from Activated Sludge Tank No. 465 after Twenty-four Hours' Aeration and One Hour Settling, Sept. 13 to Oct. 5, 1915.

Slight, . . .	0.63	.12	.08	.23	.22	4.40	.230	.0032	0.82
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Effluent from Activated Sludge Tank No. 465 after Five Hours' Aeration and One Hour Settling, Oct. 6 to Dec. 1, 1915.

V. slight, . . .	0.85	.13	.09	.33	.24	4.48	.160	.0033	0.98
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Effluent from Activated Sludge Tank No. 465 after Eight Hours' Aeration and One Hour Settling, Oct. 6 to Dec. 1, 1915.

V. slight, . . .	0.36	.10	.07	.26	.18	4.06	.140	.0020	0.88
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The following analyses show the changes taking place in the sludge in the aerating tanks, and the increase in nitrogen and the decrease in fatty matters is very marked. Experience at Lawrence has shown that the more stable sludge or filter sediment is, the lower will be the per cent. of fats present.

	PER CENT.	
	Kjeldahl Nitrogen.	Fats.
Regular sewage sludge, ...	3.12	20.2
Deposits from Aerating Tank No. 449, ...	4.06	4.3
Deposits from Aerating Tank No. 458, ...	4.99	5.0
Deposits from Aerating Tank No. 459, ...	3.54	2.1
Deposits from Activated Sludge Tank No. 465, ...	4.06	4.2

OPERATION OF TRICKLING FILTERS.

During 1915 15 trickling filters receiving sewage and 4 receiving trade wastes were operated at the station. Filters Nos. 135 and 136 have been in operation sixteen years, and Filter No. 248 eleven years. All of these filters received sewage clarified by some form of treatment during the year. Filters Nos. 135 and 136 are 10 feet in depth, and Filter No. 248 is 6 feet deep. Every sample of the effluent from Filters Nos. 135 and 136 and 72 per cent. of the samples of effluent from Filter No. 248 were stable.

The average analyses of the effluents from these 3 filters are shown in the following table:—

*Average Analyses.**Effluent from Filter No. 135.*

[Parts in 100,000.]

Quantity applied. Gallons per Acre Daily.	APPEAR- ANCE.		AMMONIA.			Kjeldahl Nitrogen.	Chlorine.	NITROGEN AS —		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
	Turbidity.	Color.	Free.	Total.	In Solution.			Nitrates.	Nitrites.			
2,145,000	2.2	.28	0.76	.18	.11	.40	8.88	1.46	.0318	1.71	4.6	78,600

Effluent from Filter No. 136.

1,357,700	2.6	.30	0.84	.23	.11	.37	8.44	1.40	.0247	1.86	4.8	133,000
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Effluent from Filter No. 248.

1,389,900	3.0	.36	1.45	.34	.17	.68	7.86	1.20	.0284	2.40	7.4	592,000
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THE DEPTH OF FILTERING MATERIAL AND TRICKLING FILTER EFFICIENCY.

It has been long recognized at Lawrence that the maximum results in efficiency of purification and volume of sewage purified in trickling filter sewage purification are obtained when the filter is of considerable depth and is constructed of comparatively fine material. There is undoubtedly a maximum depth beyond which the additional efficiency obtained is not commensurate with the additional cost of construc-

tion and which interferes with filter aeration, and a minimum depth below which economical rates of filtration cannot be maintained. In co-ordination, with the depth, a filtering material should be selected that will have the greatest efficiency at that depth when the filter is operated at economical rates and yet be coarse enough to preclude clogging of the filter, and, if possible, surface pooling.

On May 1, 1913, 4 new trickling filters were put into operation at the station, to determine at what rates trickling filters constructed of different depths and of the same material must be operated in order to obtain effluents of equal quality. Each of these filters is constructed of pieces of broken stone between $\frac{3}{4}$ of an inch and $1\frac{1}{2}$ inches in size. Filter No. 452 is 4 feet in depth; Filter No. 453, 6 feet; Filter No. 454, 8 feet; and Filter No. 455, 10 feet. The sewage applied to each has been clarified by sedimentation. We have attempted to operate each filter at such a rate that the effluents will contain about 1.5 parts nitrates in 100,000, this being the amount of nitrification which previous experience at the station has shown to be necessary, in order to insure stable effluents in trickling filter purification.

Early in 1914 these filters reached a condition of equal biological activity, and it was possible to so adjust their rates that practically equal effluents were obtained.

The average rates of operation and analyses of the effluents from these filters for the years 1914 and 1915 are given in the following tables:—

Average Analyses of Effluents, 1914.

[Parts in 100,000.]

Filter Number.	Depth (Feet).	Quantity applied. Gallons per Acre Daily.	AMMONIA.			Chlo- rine.	NITROGEN AS —		Oxygen con- sumed.	Per Cent. of Samples Stable.
			Free.	ALBUMINOID.			Ni- trates.	Ni- trites.		
		Total.		In So- lution.						
452	4	332,700	1.8600	.3050	.2006	13.20	1.63	.0065	1.89	85
453	6	585,100	1.2900	.2950	.1796	13.30	1.81	.0128	1.79	95
454	8	1,801,000	1.3575	.3715	.2292	12.98	1.66	.0126	2.17	97
455	10	3,733,000	1.7275	.3900	.2616	13.48	1.76	.0081	2.38	86

Average Analyses of Effluents, 1915.

[Parts in 100,000.]

Filter Number.	Quantity applied. Gallons per Acre Daily.	AMMONIA.			Kjel- dahl Nitro- gen.	Chlo- rine.	NITROGEN AS —		Oxygen con- sumed.	Bacteria per Cubic Cen- timeter.
		Free.	ALBUMINOID.				Ni- trates.	Ni- trites.		
			Total.	In So- lution.						
452	466,400	1.2354	.2450	.1856	.5517	9.12	1.03	.0050	1.89	444,800
453	805,500	1.2179	.2104	.1371	.4320	9.26	1.07	.0160	1.62	318,400
454	1,767,250	1.1808	.2684	.1688	.5375	9.47	1.00	.0068	1.84	200,000
455	3,501,000	1.1162	.2131	.1631	.4835	8.62	1.26	.0035	1.80	347,500

All of these filters are constructed of comparatively fine broken stone averaging about 1 inch in diameter, and they are, of course, operated under ideal conditions; that is, under such supervision and care as it is almost impossible to actually duplicate with municipal filter plants. This does not affect their comparative results, however. Judging from these results, the deeper filters are much more economical than the shallower filters, as they allow greater rates, foot for foot. The maximum average rate of filtration per foot of depth with filters of the depths studied, with equal nitrification and stability of effluent, during 1915, was as shown in the following table:—

Gallons filtered per Acre Daily per Foot of Filter Depth, with Equal Nitrification and Stability Results.

	According to 1915 Rates (Gallons).
With a 4-foot filter, ...	116,600
With a 6-foot filter, ...	134,250
With an 8-foot filter, ...	220,906
With a 10-foot filter, ...	350,100

After looking at these results the question, of course, arises as to the cause of the great rate-efficiency of the deeper filters. Why should a filter 10 feet deep allow not simply a rate two and one-half times as great as a 4-foot filter with equal purification, but a rate five or six times as great? The explanation when worked out is comparatively simple, and shows these striking results to be due simply to the hydraulics of the flow of the sewage through the filtering material. Twenty-five years ago in the first special report of the Lawrence Experiment Station, the flow of water through sand filters was de-

scribed.¹ This description, based upon experiments then made, showed that when water or sewage is applied to a sand filter, which at the time of application contains much water in its interstitial spaces, some of the applied water will, especially in filters of coarse sand, pass by the held interstitial water, instead of pushing it before it and appear at the filter outlet ahead of a large percentage of the held water. This held water is really partly interstitial water and partly absorbed water; that is, water held or absorbed by the organic matter lodged in the filter.

Now, the rate and purification results in the operation of trickling filters of different depths have to do with this flow of water and the *progressive mixture* of the applied with the held water in filters of broken stone or other coarse material, and with filtering depths varying in the cases cited in this report from 4 to 10 feet. In the early work only sand filters 5 feet in depth were studied.

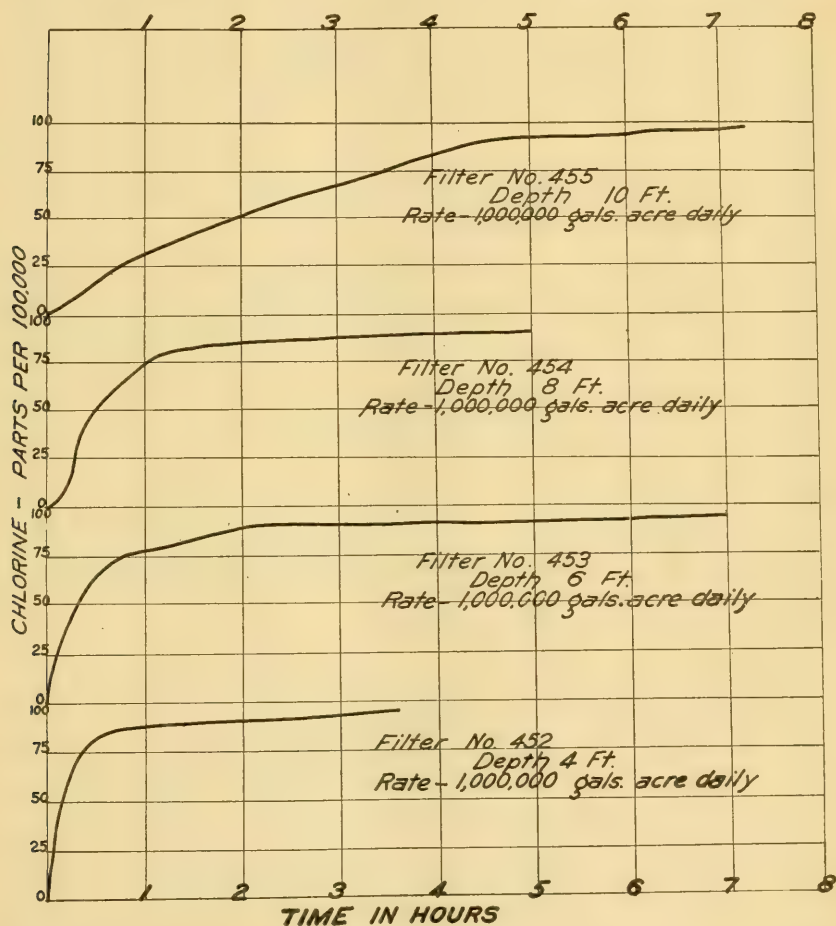
In this recent work a factor was revealed, not noticed in the sand filter studies of twenty-five years ago, which affects the results very materially. This is the simple fact, that the deeper the trickling filter up to a certain point the greater the tendency of the applied water to mix or mingle with the held water, instead of passing by this held water. This tendency to mingle as the filter depth increases, and to push the held water towards the underdrains, is great enough to cause a large percentage of the sewage passing through a 10-foot filter to be not simply twice as long in passing as through a 5-foot filter, but five or six times as long. Conversely, the rate of the deep filter may, on account of this, be from five to six times that of the shallow filter with equal purification results. This is illustrated by the following diagrams.

On these diagrams are data from experiments made at Lawrence in regard to the flow through the 4 trickling filters, — the rate and purification results of which were shown in the table, — namely, Filters Nos. 452, 453, 454 and 455, 4, 6, 8 and 10 feet deep, respectively. On the first diagram, the results are shown when each filter was being operated at the rate of 1,000,000 gallons per acre daily. In order to determine the time of passage of the water or sewage through the filters operated at this rate, and the degree of mingling of applied and held sewage, enough salt was placed at a definite time in the applied sewage to raise the chlorine 100 parts in 100,000, this amount, of course, being readily detected in the filter effluent, and increased chlorine in the effluent, due to the large application, being detected with equal readiness.

After the application of this salt sewage to each filter, samples of

¹ Special report for 1890, Purification of Sewage and Water.

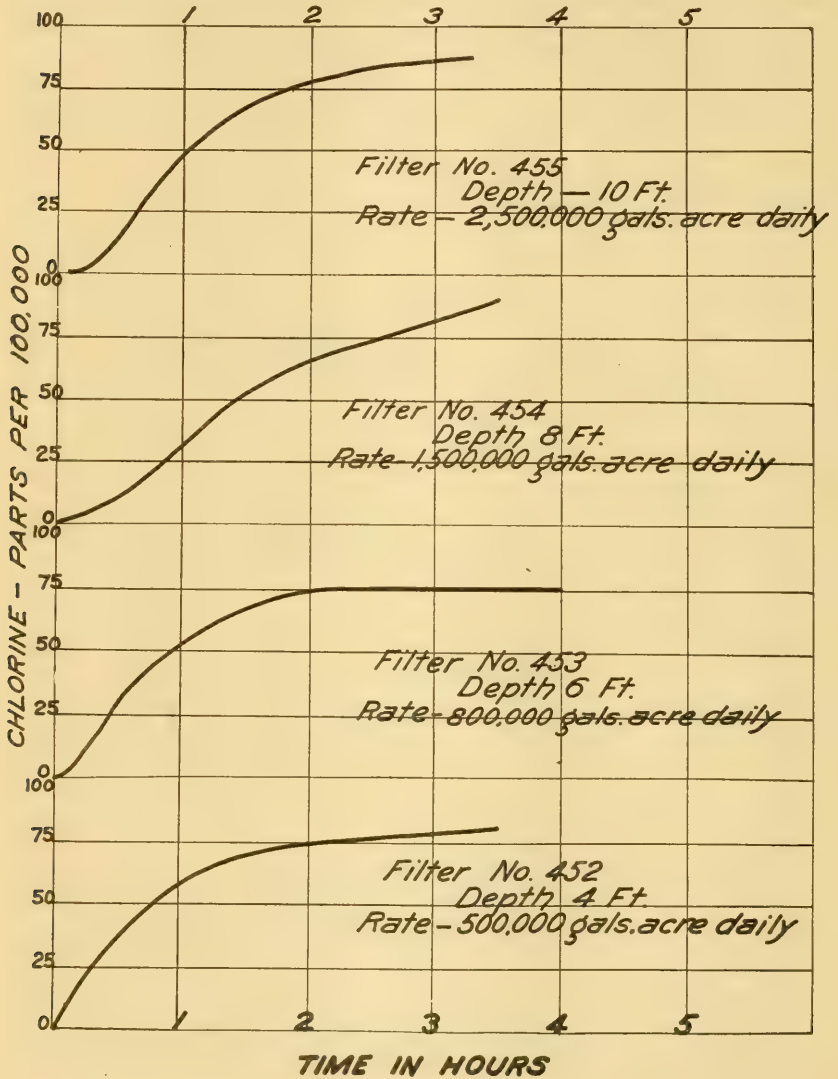
the effluent were collected every few minutes for the determination of chlorine. Examining the diagrams it will be seen that 50 per cent. of the salt sewage applied to Filter No. 452 appeared at its outlet in about twelve minutes, mingled with 50 per cent. of the held sewage; that is, the chlorine had increased to 50 parts or more in 100,000 parts; that with the 10-foot filter operating at the same rate, an hour and three-quarters elapsed before an effluent containing 50 per cent. of the salt sewage reached the underdrains; that is, instead of being



two and one-half times as long, or thirty minutes, most of this salt sewage was nine times as long in passing the deep as in passing the shallow filter. The results are given with 4 filters, and perhaps for clearness the flow may be summarized as follows:—

With a 4-foot filter, as stated, 50 per cent. of the salt sewage ap-

peared at the outlet in twelve minutes, 75 per cent. in eighteen minutes, and the remainder came slowly, mingled with the "held" sewage through many hours. With Filter No. 453, 6 feet in depth, 50 per



cent. appeared in eighteen minutes, 75 per cent. in forty-two minutes, and the remainder appeared as with the first filter, mingled with the held sewage through many hours. With Filter No. 454, 8 feet in depth, the elapsed times were forty-eight minutes and one and one-

half hours, respectively, while with the 10-foot filter, as stated, the elapsed times were one and three-quarters hours and three and one-half hours, respectively. In other words, with equal rates of operation, 50 per cent. of the sewage applied to the 4-foot filter reached the filter outlet mingled with 50 per cent. of the held sewage twelve minutes after its application, while with the 10-foot filter, one hundred and twenty-five minutes elapsed before 50 per cent. of the applied salt sewage reached the filter outlet mingled with 50 per cent. of the held sewage.

It follows, then, that at this rate — 1,000,000 gallons per acre daily — 50 per cent. of the sewage is subjected at the most to only twelve minutes' bacterial action in the 4-foot filter, while in the filter 10 feet deep, 50 per cent. receives at the most one hundred and twenty-five minutes' bacterial action.

Now to reverse the application of the data gained in this way, these 4 filters were operated at rates of 500,000, 800,000, 1,500,000 and 2,500,000 gallons per acre daily at the time of a second experiment. Applying salt sewage as before and collecting and determining the chlorine in samples from the outlets, make clear, as will be seen by an examination of the diagram, that with these rates the applied and held sewage were about equally intermingled, hence were about equal periods of time in passing through each filter. Through the shallow filter operating at a rate of 500,000 gallons per acre daily, 50 per cent. of the salt sewage appeared in fifty minutes; through the 6-foot filter, operating at a rate of 800,000 gallons per acre daily, 50 per cent. appeared in fifty-five minutes; through the 8-foot filter, operating at a rate of 1,500,000 gallons per acre daily, a little divergence was noted, owing perhaps to slight clogging in this filter, as 50 per cent. of the applied salt sewage was seventy-seven minutes in reaching the filter outlet; but through the 10-foot filter, operating at a rate of 2,500,000 gallons per acre daily, 50 per cent. of the salt sewage reached the filter outlet in one hour; that is, this Filter No. 455, two and one-half times as deep as Filter No. 452 and operated at a rate five times as great, gives equal time for sewage purification to occur as given by the shallow filter operating at one-fifth the rate and hence equal purification. It is evident, moreover, from the diagram that the rate of the deep filter could have been at least 3,000,000 gallons per acre daily. These results show very clearly the reasons for the great economy of deep compared with shallow trickling filters. These filters are constructed of stone between $\frac{3}{4}$ of an inch and $1\frac{1}{2}$ inches in diameter. Filters of larger or smaller stone allow differing times of passage and degree of intermingling, hence different but comparative results.

Trickling Filters Nos. 472, 473, 474 and 475.

Filters Nos. 472 to 475, inclusive, were put into operation on April 10, 1915. They are similar in construction to Filters Nos. 452 to 455, inclusive, except that the stone is much coarser, and they are operated in the same manner as these latter filters in a study of the rates of operation necessary for equal efficiency of filters from 4 to 10 feet deep. The average rate of Filter No. 472 for the year was rather higher than it should have been, as shown by the low nitrates and degree of stability of its effluent, compared with the effluents from the other filters of this series. Apparently, Filter No. 475 might have been operated at a somewhat higher rate.

The average analyses of the effluents from these 4 filters are given in the following table, and on diagrams beyond are presented the same facts in regard to these filters of coarser material as on the previous diagrams concerning the depth and efficiency of Filters Nos. 452 to 455, inclusive. These diagrams show that the deeper filter, No. 475, 10 feet in depth, can operate at a rate six or seven times as great as Filter No. 472, 4 feet in depth, with the same efficiency and purification.

*Average Analyses.**Effluent from Filter No. 472.*

[Parts in 100,000.]

Quantity applied. — Gallons per Acre Daily.	APPEAR- ANCE.		AMMONIA.			Kjeldahl Nitrogen.	Chlorine.	NITROGEN AS —		Oxygen consumed.	Bacteria per Cubic Centimeter.
	Turbidity.	Color.	Free.	Total.	In Solution.			Nitrates.	Nitrites.		
464,200	3.0	.39	1.3000	.2530	.1764	.5800	7.71	0.57	.0257	2.00	1,217,140

Effluent from Filter No. 473.

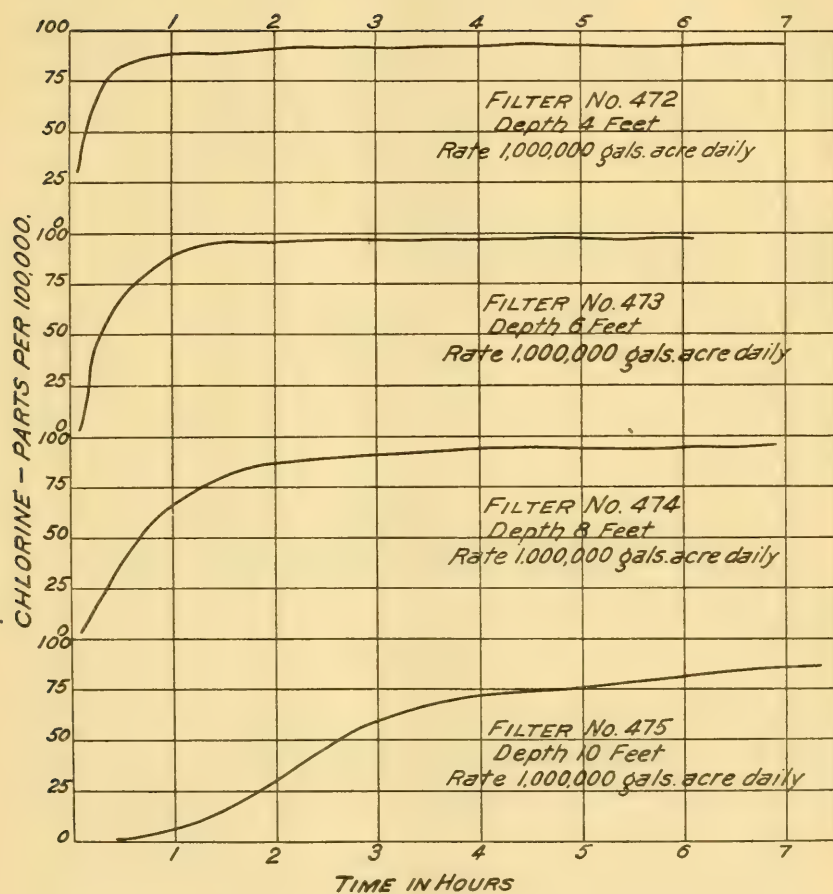
616,200	3.0	.39	0.8257	.2429	.1649	.5003	7.60	0.99	.0204	1.96	798,571
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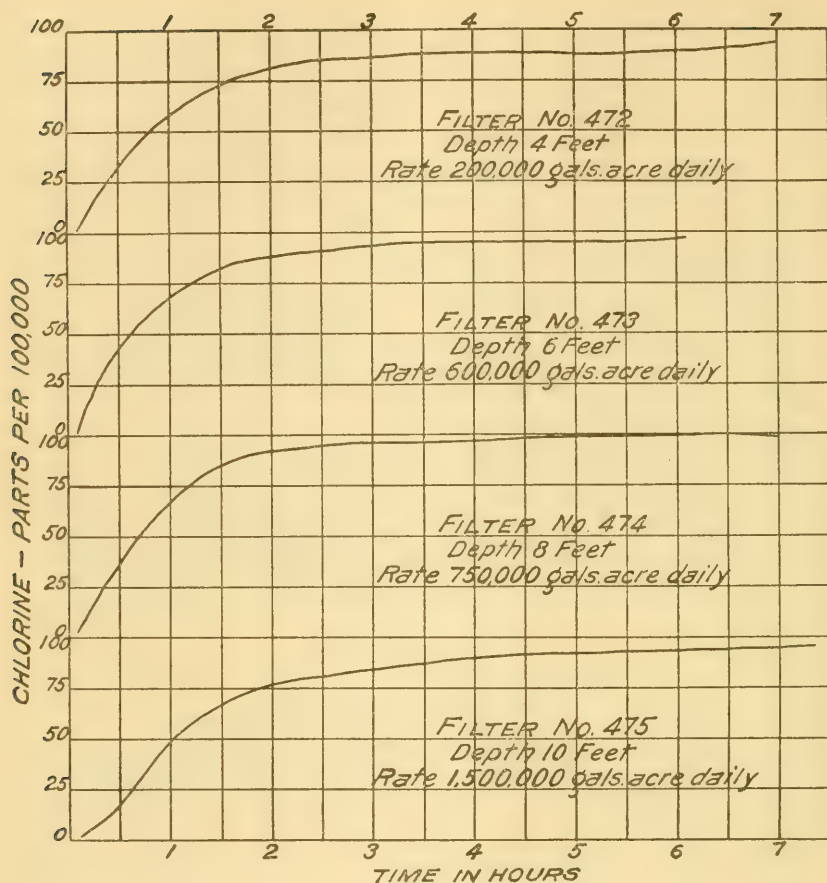
Effluent from Filter No. 474.

674,600	2.8	.35	0.9897	.2406	.1906	.5467	7.62	0.87	.0272	1.86	640,700
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Effluent from Filter No. 475.

738,100	2.6	.37	0.7386	.2316	.1429	.5047	7.93	1.74	.0265	1.74	700,000
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Stability of Effluents from Trickling Filters Nos. 452 to 455, inclusive, and Trickling Filters Nos. 472 to 475, inclusive.

FILTER NUMBER.	PER CENT. OF SAMPLES.	
	Putrescible.	Stable.
452, ...	6	94
453, ...	0	100
454, ...	0	100
455, ...	12	88
472, ...	86	14
473, ...	29	71
474, ...	14	86
475, ...	0	100

Absorption of Oxygen by Trickling Filter Effluents.

When Filters Nos. 452, 453, 454 and 455 were started, 1.50 parts in 100,000 of nitrogen as nitrates was selected as the standard to be attained by all 4 filters to insure satisfactory effluents. With the application of weaker sewage during part of the year and the use of the Osgood Street sewage since September, the nitrates have dropped to about 1.0 parts in 100,000.

The average amount of oxygen absorbed from nitrates and dissolved oxygen by these effluents during twenty-four hours' incubation at 70° F. is shown in the following table:—

[Parts in 100,000.]

OXYGEN ABSORBED FROM —	Effluent from Filter No. 452.	Effluent from Filter No. 453.	Effluent from Filter No. 454.	Effluent from Filter No. 455.
Nitrates, ...	0.75	0.79	0.77	0.93
Dissolved oxygen, ...	0.40	0.38	0.22	0.16
Total, ...	1.15	1.17	0.99	1.09
Average total since filters were started, .	1.27	1.12	0.97	1.24

METHOD OF RATING THE SIZE OF BROKEN STONE USED IN THE CONSTRUCTION OF TRICKLING FILTERS.

All crushed or broken stone is screened through circular, rotary screens having round openings, and it has been customary to express the size of the pieces of such stone as being between the diameter of the ring through which all the pieces will pass and the diameter of the ring through which none of the pieces will pass. Both the angle of the screen and the speed of rotation have a decided influence on the size of the pieces passing a given sized ring or opening. The mineralogical nature of the stone also influences the shape and hence the volume of each piece of stone passing through the rings. Therefore, mistakes and inaccuracies arise in expressing the size of the pieces used in the construction of trickling filters. This can be largely obviated, however, by expressing size as the actual volume of each piece of stone, calculating this from the average weight and specific gravity of a number of selected pieces. Making this rating of the broken stone used in the trickling filters at Lawrence has given the following results:—

FILTER NUMBER.	Average Volume of Pieces of Stone (Cubic Centimeters).	Size of Screen (Inches).
135, ...	0.52	$\frac{1}{4}$ -1
136, ...	0.52	$\frac{1}{4}$ -1
248, ...	3.03	-1
449, ...	5.06	1-2
452, ...	3.90	$\frac{3}{4}$ -1 $\frac{1}{2}$
453, ...	3.73	$\frac{3}{4}$ -1 $\frac{1}{2}$
454, ...	4.06	$\frac{3}{4}$ -1 $\frac{1}{2}$
455, ...	5.33	$\frac{3}{4}$ -1 $\frac{1}{2}$
457, ...	4.88	1-2
458, ...	4.82	1-2
459, ...	4.51	1-2
472, ...	25.2	-
473, ...	27.8	-
474, ...	28.5	-
475, ...	29.4	-

¹ Twenty-five per cent. finer than 1.

OPERATION OF CONTACT FILTERS.

Contact Filters Nos. 175 and 421 to 428, inclusive, and Secondary Contact Filters Nos. 443 and 456.

During 1915 11 contact filters were operated, one of which, No. 175, has been in operation for about fifteen years in a study of permanency; 8 were started during 1911 in a comparative study upon the effect of different methods of operation; and 1 was started during 1912 as a secondary contact filter, receiving the effluent from a primary contact filter. Filter No. 456 was started last year to study the effect on loss of open space of sewage which had been clarified by treatment in a slate aerating tank.

Filter No. 175, first put into operation in June, 1901, is constructed of coke of such size that all will pass through a sieve having a 1-inch mesh, 75 per cent. through a sieve having a $\frac{1}{2}$ -inch mesh and practically none through a sieve with a $\frac{1}{4}$ -inch mesh. This filter has always received sewage that has passed through a coke or coal strainer; it is filled once daily in one dose, stands full two hours before draining and is allowed to rest every sixth week. The loss of open space at the end of the year was 35 per cent.

Studies of the Effect of Methods of Operation of Contact Filters.

Filters Nos. 421 to 428, inclusive. — These 8 filters were first put into operation on Jan. 18, 1911. Each is constructed of 33 inches in depth of pieces of soft coal clinker having a diameter between $\frac{1}{4}$ and $1\frac{1}{4}$ inches, and is operated with settled sewage. The difference in the methods of operating these filters is shown in the following table: —

Filter Number.	METHOD OF FILLING.	Contact Period (Hours).	Number of Cycles Daily.
421	Rapidly from surface, ...	8	1
422	Rapidly from surface, ...	4	1
423	Rapidly from surface, ...	2	1
424	Rapidly from surface, ...	1	1
425	Rapidly from surface, ...	1	2
426	Rapidly from surface, ...	1	3
427	Rapidly from bottom, ...	1	1
428	Slowly from surface, with distributor 12 inches above surface, .	1	1

The differences in the degree of purification due to the different methods of operation are relatively small. The longer period of contact tends to produce a more stable effluent but with greater loss of open space. The number of fillings daily has little effect on the stability. With three fillings daily there is a greater proportional decrease of open space than with two fillings daily. Filling from the bottom instead of the top decreases the stability of the effluent but gives the least loss of open space.

Briefly summed up, these results indicate that for conditions similar to those in these experiments, the best results will be obtained by filling twice daily from the top with as much aeration as practicable and a period of contact somewhat longer than an hour.

Double Contact Filtration.

Filter No. 443, containing 21 inches in depth of broken stone pebbles, all of which will pass a screen with a $\frac{1}{2}$ -inch mesh, 43 per cent. a screen with a $\frac{1}{4}$ -inch mesh and practically none a screen with a $\frac{1}{8}$ -inch mesh, was put into operation on April 21, 1912. The effluent from Filter No. 425 has been applied to this filter at an average rate of 650,000 gallons per acre daily, the filter being filled twice daily and allowed to stand one hour before draining. The effluent has contained

on an average 1.61 parts in 100,000 nitrates and has been perfectly stable. The loss of open space at the end of the year was 32 per cent., 4 per cent. less than a year ago.

Contact Filtration of Sewage clarified by Aeration.

Filter No. 456, containing 3 feet in depth of clinker passing a 1-inch screen and held back by a $\frac{1}{2}$ -inch mesh screen, was put into operation on Jan. 1, 1914, to study the effect of clarification of sewage by aeration in a slate tank on the operation of contact filters. The effluent from aerating Tank No. 449 was applied in three fillings at a rate of about 1,300,000 gallons per acre daily. The average nitrates in the effluent were higher than last year, being 0.82 parts in 100,000 against 0.60 parts in 100,000, and all samples were stable. The loss of open space at the end of the year was 11 per cent. against 22 per cent. a year ago.

Filter No. 426, which was also filled three times daily, but with a sewage which was merely settled, lost 43 per cent. of its open space after two years' operation. From this it is evident that preliminary clarification of sewage applied to contact filters prolongs the life of the filter, and as the rate depends on the open space, it increases the rate at which the filter may be operated.

The average analyses of the effluents from these various contact filters are shown in the following tables:—

Average Analyses.

Effluent from Filter No. 175.

[Parts in 100,000.]

Quantity applied. Gallons per Acre Daily.	APPEAR- ANCE.		AMMONIA.			Kjeldahl Nitrogen.	Chlorine.	NITROGEN AS —		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
	Turbidity.	Color.	Free.	Total.	In Solution.			Nitrates.	Nitrites.			
439,215	1.6	.24	0.56	.13	.09	.28	7.30	1.63	.0180	1.17	6.2	401,800

Effluent from Filter No. 421.

255,500	2.1	.30	0.59	.16	.11	.36	8.15	0.23	.0321	1.34	7.6	759,500
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Effluent from Filter No. 422.

272,400	2.2	.30	0.73	.16	.11	.35	8.75	0.75	.0206	1.35	6.4	890,900
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*Average Analyses — Concluded.**Effluent from Filter No. 423.*

[Parts in 100,000.]

Quantity applied. Gallons per Acre Daily.	APPEAR- ANCE.		AMMONIA.			Kjeldahl Nitrogen.	Chlorine.	NITROGEN AS —		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
	Turbidity.	Color.	Free.	Total.	In Solution.			Nitrates.	Nitrites.			
290,700	2.5	.33	1.04	.19	.13	.43	9.65	0.80	.0176	1.57	7.1	1,277,700

Effluent from Filter No. 424.

291,000	2.6	.32	0.91	.19	.13	.38	9.16	9.69	.0216	1.70	7.0	883,600
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Effluent from Filter No. 425.

464,000	2.6	.33	0.94	.20	.14	.46	8.60	0.83	.0084	1.70	6.8	738,630
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Effluent from Filter No. 426.

454,300	2.8	.33	0.75	.23	.14	.45	7.63	0.78	.0039	1.90	7.0	842,540
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Effluent from Filter No. 427.

312,400	2.5	.33	1.55	.22	.15	.48	8.55	0.40	.0190	1.75	8.8	1,376,300
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Effluent from Filter No. 428.

301,000	2.7	.32	1.14	.21	.13	.45	8.57	0.95	.0522	1.73	7.4	864,500
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Effluent from Filter No. 443.

455,700	1.8	.27	0.46	.15	.12	.31	8.90	1.61	.0364	1.31	3.6	770,000
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Effluent from Filter No. 456.

1,119,000	3.3	.32	1.73	.16	.10	.44	8.39	0.82	.0120	1.19	8.9	1,070,000
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Stability of Effluents from Contact Filters, 1912 to 1915, Inclusive, and Total Loss of Open Space.

FILTER NUMBER.	Per Cent. Loss of Open Space.	Nitrates (Parts in 100,000).	PER CENT. OF SAMPLES.		
			Putrescible.	Doubtful.	Stable.
175, ...	—	1.76	0.0	1.5	98.5
421, ...	39	0.13	1.4	11.1	87.5
422, ...	40	0.47	8.2	12.2	79.6
423, ...	32	0.56	31.4	6.9	61.7
424, ...	32	0.56	28.9	2.6	68.5
425, ...	36	0.57	32.8	6.7	60.5
426, ...	58	0.52	19.0	6.8	74.2
427, ...	24	0.32	42.9	5.3	51.8
428, ...	34	0.88	20.7	1.4	77.9
443, ...	32	1.50	0.0	0.0	100.0
456, ...	11	0.71	0.0	0.0	100.0

INTERMITTENT SAND FILTERS OPERATED WITH UNTREATED SEWAGE.

Filters Nos. 1, 2, 4, 5C, 6 and 9A.

These 6 sand filters are each $\frac{1}{200}$ of an acre in area, and are situated out-of-doors. At the end of 1915, Filters Nos. 1, 2, 4 and 6 had been operated continuously for nearly twenty-eight years, and Filter No. 9A had been operated twenty-five years. Regular station sewage without preliminary clarification has always been applied to these filters, and for some years it has been the practice to apply only as much sewage as can be purified without increasing the amount of organic matter stored within the filters. Since 1893, a period of about twenty-two years, all of these filters have been operated without the removal of any sand from the surface. The depth and size of sand of which each of these filters is constructed, the date when first put into operation, and the total volume of sewage treated upon each filter since it was started are shown in the following table: —

FILTER NUMBER.	Depth (Feet).	Effective Size of Sand (Millimeter).	Date first operated.	Actual Volume of Sewage applied since Start (Gallons).
1, ...	5	0.48	Jan. 10, 1888	2,763,896
2, ...	5	0.08	Dec. 19, 1887	1,591,551
4, ...	5	0.04	Dec. 19, 1887	961,865
5C, ...	5	0.22	July 20, 1905	743,765
6, ...	3 $\frac{2}{3}$	0.35	Jan. 12, 1888	2,287,882
9A, ...	5	0.17	Nov. 18, 1890	2,300,607

The average analyses of the effluents from these filters are shown in the following table: —

*Average Analyses.**Effluent from Filter No. 1.*

[Parts in 100,000.]

Quantity applied. — Gallons per Acre Daily.	APPEARANCE.		AMMONIA.		Chlorine.	NITROGEN AS—		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
	Turbidity.	Color.	Free.	Total Albuminoid.		Nitrates.	Nitrites.			
49,000	0.3	.17	.6061	.0408	7.61	2.50	.0004	.52	—0.1	21,800

Effluent from Filter No. 2.

34,300	0.1	.10	.0680	.0069	7.40	2.23	.0023	.26	—0.3	4,500
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Effluent from Filter No. 4.

18,600	0.1—	.07	.0048	.0115	7.20	2.60	.0003	.16	0.1	192
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Effluent from Filter No. 5C.¹

47,400	0.3	.19	.9350	.0549	8.48	2.83	.0002	.59	—0.4	11,000
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Effluent from Filter No. 6.

45,200	0.3	.17	.0583	.0455	7.94	2.43	.0003	.44	—0.1	10,800
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Effluent from Filter No. 9A.

46,050	0.1	.21	.0448	.0415	8.27	2.24	.0002	.55	0.1	3,950
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¹ Filter stopped May 14.

WASTES FROM WOOLEN MILLS.

Certain changes have been made in the processes at a woolen mill since past investigations were completed, resulting in changes in the nature of the wastes. Little or no wool-scouring liquors were produced during 1915, and there was enough waste aluminum chloride from one process carried on in the mill to furnish from two-thirds to three-fourths of the necessary precipitant for chemical treatment of the wastes.

The average volume of wastes discharged during ten or twelve hours

of the day was around 2,000,000 gallons. The wastes discharged during the remainder of the twenty-four hours probably did not require treatment. Aluminum chloride and alum, equivalent to 8 or 9 grains per gallon, or 1,150 to 1,500 pounds of alum per million gallons, were added to the wastes at the mill. Sedimentation from ten to forty minutes was allowed in tanks holding about 125,000 gallons. It was stated by the mill chemist that if an excess of coagulant is used a large amount of flocculent matter is carried off into the stream, and that if the tanks were larger from 10 to 12 grains of alum would be used.

Many samples from the outlet of these tanks showed that but little clarification had been accomplished at the mill, and at the station an average of 6.3 grains per gallon, or about 900 pounds per million gallons, additional alum was found necessary for complete clarification. With the proper amount of alum a large proportion of the dye in the waste is removed, and a very clear, supernatant liquor results. Occasional samples from the outlet of the tanks showed a fairly satisfactory precipitation in the tank.

The following table shows the clarification resulting from adding an average of 6.3 grains additional alum per gallon to the waste liquor from the outlet of the settling tanks:—

Waste Liquor from the Outlet of Settling Tanks.

[Parts in 100,000.]

AMMONIA.			Oxygen consumed.
Free.	ALBUMINOID.		
	Total.	In Solution.	
.29	.29	.12	8.29

Waste Liquor after Additional Precipitation.

.23	.08	—	1.79
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Besides chemical precipitation of these wastes at the station experiments were started on filtration through deep trickling filters. On September 20, 2 filters, Nos. 480 and 481, containing 7 feet in depth of stone passing a 1-inch ring and retained by a $\frac{1}{4}$ -inch ring, were started at a rate of 500,000 gallons per acre daily. This rate was increased to 1,000,000 gallons per acre daily on October 2. Filter No. 480 received the waste as it flowed from the settling tank without further settling, and Filter No. 481 received the effluent from Filter No. 480.

The purification accomplished by these filters was very satisfactory except as to color removal. They reduced the color considerably, but when the wastes were highly colored, the effluents still retained an objectionable amount of color. Filter No. 480 received an average of 147 parts in 100,000 suspended matter, but as yet has done no "unloading," the effluent being practically free from sediment. The fats in the wastes averaged 13.3 parts in 100,000. This is approximately the same amount as was present in the wastes in 1909, when experiments at the station in filtering through sand at high rates were unsuccessful on account of the clogging of the sand by fats.

The average analyses of the waste applied to and of the effluents from these filters are shown in the following table:—

Average Analyses.

Effluent from Settling Tanks applied to Filter No. 480.

[Parts in 100,000.]

APPEARANCE.		AMMONIA.			KJELDAHL NITROGEN.		Chlorine.	NITROGEN AS—		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
Turbidity.	Color.	Free.	Total.	In Solution.	Total.	In Solution.		Nitrates.	Nitrites.			
-	-	.38	.29	.12	.78	.30	15.15	-	-	6.14	7.6	2,482,000

Effluent from Filter No. 480.

V. slight	Pale green	.20	.06	-	.21	-	-	.43	.0009	1.39	3.9	252,000
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Effluent from Filter No. 481.

V. slight	Pale green	.09	.03	-	.12	-	-	.62	.0010	0.77	5.4	374,000
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Average Solids.

Effluent from Settling Tanks applied to Filter No. 480.

[Parts in 100,000.]

UNFILTERED.			FILTERED.			IN SUSPENSION.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
63.9	26.9	37.0	49.2	13.6	35.6	14.7	13.3	1.4

PAPER MILL WASTES.

On July 1 investigations were begun in regard to methods for the purification of the washer wastes from a paper mill on the Neponset River, varying in volume from 200,000 to 400,000 gallons per day. This waste is a thick, turbid liquor containing much matter in suspension. It varies in color according to the stock worked up or the dye being used.

The raw stock used is largely old rope and cotton rags. None of the rotary digester liquors are mixed with these washer wastes. At times when a certain grade of red paper is being made, the paper machine wastes are so highly colored that in order to prevent interference with the operations of mills below on the stream, these wastes are mixed with the washer wastes. At such times the combined wastes may reach a total of 550,000 gallons a day.

Two trickling filters, Nos. 471 and 476, containing 7 feet in depth of crushed stone passing a 1-inch ring and retained by a $\frac{1}{4}$ -inch ring, were put into operation on July 1 at a rate of 500,000 gallons per acre daily. Filter No. 471 received the raw washer wastes, and Filter No. 476 received the effluent from Filter No. 471.

On July 27, a sand filter, No. 478, containing $3\frac{1}{2}$ feet in depth of sand of an effective size of 0.25 millimeter, was started at a rate of 100,000 gallons per acre daily with the effluent from Filter No. 476. On July 29, another sand filter, No. 479, of the same construction as Filter No. 478, was started. This filter received waste which had been well clarified by a slight excess of sulphuric acid, settled and then made slightly alkaline. This treatment requires 3,650 pounds of acid per million gallons of waste, but produces a liquor that can be easily purified upon a sand filter at the rate of 100,000 gallons per acre daily, as shown by the analytical results for Filter No. 479 in the table following. Experiments late in the year indicated that at times, at least, the waste can be more economically and efficiently treated with aluminum sulphate than with acid.

The 2 trickling filters have produced rather remarkable results considering the character of the waste liquor applied. Filter No. 471, 7 feet in depth, produces a stable, fairly clear effluent, containing some nitrates, and the effluent from Filter No. 476 has always been clear, low in color, high in nitrates, stable and with but little sediment.

Tables showing the average analytical results are given here:—

*Average Analyses.**Washer Waste from Paper Mill.*

[Parts in 100,000.]

APPEARANCE.		AMMONIA.			KJELDAHL NITROGEN.		Chlorine.	NITROGEN AS —		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
Turbidity.	Color.	Free.	ALBUMINOID.		Total.	In Solution.		Nitrates.	Nitrites.			
			Total.	In Solution.								
-	-	.33	1.07	.75	2.68	2.15	14.00	-	-	20.3	40.2	947,000

Effluent from Filter No. 471.

Decided	Brown	.17	0.62	.39	1.55	-	-	.13	.0065	7.61	39.0	-
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Effluent from Filter No. 476.

Slight	Brown	.11	0.35	.28	1.03	-	-	.83	.0223	5.40	33.3	166,000
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Effluent from Filter No. 478.

V. slight	1.10	.17	0.18	-	0.53	-	-	.88	.0163	3.34	28.4	28,000
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Chemically Precipitated Waste applied to Filter No. 479.

-	-	.31	0.74	.66	1.88	-	-	-	-	12.0	-4.5 ¹	370,000
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Effluent from Filter No. 479.

V. slight	0.55	.42	0.13	-	0.30	-	-	.06	.0030	1.85	15.5	38,100
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¹ Made alkaline before applying to filter.*Average Solids.**Washer Waste from Paper Mill.*

[Parts in 100,000.]

UNFILTERED.			FILTERED.			IN SUSPENSION.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
214.6	122.0	92.6	148.1	81.9	66.2	66.5	40.1	26.4

DIGESTER LIQUORS.

The most difficult paper mill wastes to purify are the digester liquors, as they are too concentrated and too alkaline to be treated by bacterial action without dilution. In mills using soda as the alkali, the wastes are frequently evaporated to a thick syrup and burned in a long rotary kiln. The soda is then recovered from the ash. These liquors are sometimes used for laying the dust on town or city streets.

During September and October samples of digester wastes were received at the station from a mill in the Neponset valley and tested for possible methods of treatment. The bacteria in the wastes averaged only 65 per cubic centimeter, and the organic content over 2,000 parts in 100,000. The alkalinity averaged 930 parts in 100,000, part of which was caustic, precluding any bacterial treatment. The alkali being largely lime, an attempt was made to precipitate it as CaCO_3 by passing CO_2 through the hot liquor. This treatment was hardly successful, as the resulting precipitate was fine and crystalline and very slow in settling. The reduction of organic matter and lime was between 10 per cent. and 20 per cent. Various other precipitants were tried without success, and the only possible conclusion was that the waste must be evaporated or diluted and disposed of with other wastes.

Average analyses of the samples of waste are shown in the following table:—

Average Analysis of Digester Liquor.

[Parts in 100,000.]

AMMONIA.			KJELDAHL NITROGEN.		Chlorine.	Oxygen consumed.	Alkalinity.
Free.	ALBUMINOID.						
	Total.	In Solution.	Total.	In Solution.			
8.20	11.7	9.2	20.3	18.7	187	487	930

Average Solids.

[Parts in 100,000.]

UNFILTERED.			FILTERED.			IN SUSPENSION.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
3,512	2,066	1,446	3,396	1,977	1,419	116	89	27

THE EFFECT ON BACTERIA OF CERTAIN CLOTH-WASHING LIQUORS WHEN MIXED WITH SEWAGE.

The Department was asked what effect cloth-washing liquors in relatively large volumes from a proposed mill would have on the sewage-disposal area of Westborough. The principal kinds of liquors from the washing of cloth were secured and analyzed at the station. The kier liquor was alkaline to phenolphthalein to the extent of 432 parts in 100,000, and practically sterile. Three sour wash liquors were from 98 to 155 parts in 100,000 acid, and also very low in bacteria. Two kier wash liquors were low in alkalinity and contained over 5,000,000 bacteria. This large number was probably due to growth between the time of collection and examination. None of the samples contained free chlorine, and any bactericidal property of the wastes was probably due to acidity or alkalinity.

Station sewage was diluted with 10, 25 and 50 per cent. of these wastes, allowed to stand four hours and then plated. A brief summary of the bacterial reduction resulting from the mixing of the different wastes with sewage is shown in the following table:—

KIND OF WASTE.	AVERAGE PER CENT. REDUCTION IN TOTAL BACTERIA BY —		
	10 Per Cent. Waste.	25 Per Cent. Waste.	50 Per Cent. Waste.
Kier liquor, ...	54	97.3	99.94
Kier wash waters, ...	56 ¹	5.9	12.50
Sour washes, ...	44 ¹	97.6	99.97

¹ Increase.

Portions of the diluted acid wastes were also neutralized just before plating, in order that the acid might not prevent the full development of the bacteria on the plates, and the results were practically the same as those from plates without this precaution. The results in the previous table show the effects of the separate wastes. In any plan of disposal the wastes would become more or less mixed before mingling with the domestic sewage, and the acid and alkaline wastes would tend to neutralize each other, decreasing the sterilizing effect on sewage.

LEATHERBOARD WASTE.

At a certain factory in which 1½ tons of dry leatherboard are made each day, the liquid wastes, amounting to 83,000 gallons per day, were stated to cause a nuisance at the point of discharge, pooling of

the waste and putrefaction of the organic matters occurring. The stock used consists of scrap leather, mixed paper, leatherboard scraps and jute. The process of treating the stock is similar to that in a paper mill, and the stock is treated with an aniline dye to color it reddish brown or a tan bark color.

Experiments at Lawrence showed this waste to be very easily clarified and rendered inoffensive by chemical precipitation. Various coagulants were tried, but aluminum sulphate at the rate of 2,000 pounds per million gallons has proved the most efficient. Wastes collected at the factory and received at the experiment station during a number of weeks were always reddish brown in color, very turbid, and contained considerable matter in suspension. Odors developed in them in a few days when kept at laboratory temperatures. Treatment with sulphate of alumina in the proportion stated resulted in an efficient coagulation and precipitation, and the production of an inoffensive, dark, straw-colored liquid which was entirely stable, as shown by laboratory tests. This treatment caused a reduction and removal of 90 per cent. of the organic matters present.

It was evident from this investigation that the installation of settling tanks of proper capacity and construction, for which there is ample space in the yard of the factory, and treatment of the liquid wastes with aluminum sulphate would result in the production of a waste liquid which probably could be allowed to flow from the factory without further treatment, such as filtration.

Average analyses of the samples of liquid received at the station and of the effluent from chemical precipitation follow:—

Waste from Settling Tank at Works.

[Parts in 100,000.]

Solids in Suspension.	AMMONIA.			Chlorine.	Oxygen. consumed.
	Free.	ALBUMINOID.			
		Total.	In Solution.		
47.1	.14	.58	.18	8.10	100.0

Chemically Precipitated Waste. — Supernatant Liquor.

0.0	.08	.08	.08	—	52°0
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EXPERIMENTS UPON WASTES FROM FOURTEEN TANNERIES.

Similar experiments were made on the wastes from 14 tanneries and plants handling hides in Peabody. These wastes, and consequently the treatment necessary for their clarification, vary from time to time, and the results of these experiments, while important from a practical point of view, are not included here. Reports in regard to this work were made to the Engineering Division.

POLLUTION OF SHELLFISH.

The question of pollution of clams obtained along the Massachusetts coast and the possibility of obtaining clams free from pollution having become quite prominent again in the work of late, investigations were made in the laboratories to demonstrate that clean clams can be obtained, but that shucking, even under the best conditions, may cause a certain amount of contamination.

Clams were obtained from Castle Neck Creek off Castle Neck, south of the lighthouse at Ipswich. This clam flat is as free from sewage pollution as any along the northern portion, at least, of the Massachusetts coast. The results of the examinations of these clams are given in the following table.

It will be noticed that the numbers of bacteria in the unshucked clams were low at first, but coli were found in 0.1 of a cubic centimeter on the day of collection. Examinations of the shellwater were made each day for ten days, five clams being taken for each test. The number of bacteria at 20° C. increased from 3,000 to a maximum of 75,000 per cubic centimeter, and the total colonies growing at 37° C. from 300 to 900 per cubic centimeter. On at least half of the days, however, coli were not found in any of the clams tested either in .01, 0.1 or 1.0 cubic centimeter of the clam water examined.

An equal number of clams from the same source were shucked under as good conditions as feasible, the clams being placed in a wire basket and water of good quality run over them rapidly from a faucet for several minutes before opening with a knife. Every precaution was taken as regards cleanliness, except sterilization of the worker's hands, of the knife and wire basket, and of the water used in washing the clams. Notwithstanding the degree of cleanliness used in this work, the number of bacteria found was very much greater than in the unshucked clams, as shown by the table. The number of bacteria growing at 20° C. and at 37° C. increased enormously, and coli were found in as small a volume as .01 of a cubic centimeter of the clam water in every test made during the six days of experiment.

Considering the bacterial results obtained by this careful and cleanly manner of shucking, the high bacterial results obtained in the examination of shucked clams sold in the ordinary market is not to be wondered at. Observations of the conditions under which clams are often shucked show these conditions to be far from sanitary.

Average of Five Clams.

STORAGE (DAYS). ¹	BACTERIA PER CUBIC CENTIMETER.			B. COLI.				
	4 Days, 20° C.	24 HOURS, 37° C.		.0001 c. c.	.001 c. c.	.01 c. c.	.1 c. c.	1 c. c.
		Total.	Red.					
Start, ...	3,000	300	10	-	0	0	+	+
2, ...	1,200	500	80	-	0	0	0	0
3, ...	7,300	630	100	-	0	0	0	+S
4, ...	5,000	266	100	-	-	0	0	+
5, ...	1,400	540	230	-	0	0	0	0
7, ...	17,000	420	100	-	0	0	0	0
8, ...	75,000	860	100	-	-	0	0	0
10, ...	29,300	900	40	-	-	0	0	+

Average of Five Shucked Clams.

Start, ...	72,000	140,000	130,000	+	+	+	+	+
2, ...	107,000	69,000	12,000	0	0	+	+	+S
3, ...	90,000	50,000	10,000	0	0	+	+	+
4, ...	460,000	65,000	35,000	0	+	+	+	+
6, ...	200,000	18,000	10,000	0	0	+	+	+

¹ Clams kept at 42° F.

S = fermenting bacteria overgrown by sewage streptococcus.

PURIFICATION OF WATER.

LAWRENCE CITY FILTERS.

The water supply of the city of Lawrence is taken from the Merri-mack River, purified by sand filtration. Two filters are in use. The older one was constructed in 1893, and dividing walls separating it into three sections were built in 1902. This filter contains about 4 feet in depth of sand of an effective size of 0.25 millimeter, and the net filtering area is about 2.2 acres. It is not covered and has an earth bottom, through which some ground water finds its way into the underdrains and becomes mixed with the filtered water. The average rate of operation during the past few years has been about 1,000,000 gallons per acre daily.

In November, 1907, a modern covered filter of concrete construction was put into operation to supplement the supply. This filter is $\frac{3}{4}$ of an acre in area and contains about $4\frac{1}{2}$ feet in depth of sand of an effective size of 0.25 millimeter. The average rate of operation during the year was about 3,000,000 gallons per acre daily.

The effluents from both of these filters flow into the same pump-well, from which they are pumped into the distributing reservoir. The difference in the degree of purification produced is shown by the average analyses in the tables following. As has been the case for the last few years, the effluent from the older filter was better bacterially than that from the covered filter, which is operated at a much higher rate.

The average analyses of the effluents from these filters, and of the samples from other points on the Lawrence water supply system, are shown in the following tables:—

*Average Chemical Analyses. .**Merrimack River. — Intake of the Lawrence City Filters.*

[Parts in 100,000.]

Temperature (Degrees F.).	APPEAR- ANCE.		AMMONIA.			Chlorine.	NITROGEN AS —		Oxygen consumed.	Iron.	Alkalinity.	Soap Hardness.
	Turbidity.	Color.	Free.	ALBUMINOID.			Nitrates.	Nitrites.				
				Total.	In Solution.							
51	0.3	.35	.0190	.0214	.0177	.47	.021	.0002	.64	.0540	1.6	1.8

Effluent from the Lawrence City Filter (Old Filter).

53	0.1	.31	.0150	.0081	—	.48	.033	.0002	.45	.1070	1.8	2.0
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Effluent from the Lawrence City Filter (New Filter).

52	0.0	.26	.0057	.0074	—	.43	.027	.0000	.44	.0230	1.4	1.7
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Water from the Outlet of the Distributing Reservoir.

52	0.1	.31	.0062	.0080	—	.46	.034	.0001	.40	.0680	1.7	2.0
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Water from a Tap at Lawrence City Hall.

53	0.1	.30	.0052	.0072	—	.46	.037	.0001	.40	.0800	1.7	2.0
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Water from a Tap at the Lawrence Experiment Station.

50	0.1	.32	.0038	.0072	—	.46	.035	.0001	.42	.0750	1.7	2.0
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*Average Bacterial Analyses.**Merrimack River. — Intake of the Lawrence City Filters.*

BACTERIA PER CUBIC CENTIMETER.			PER CENT. OF BACTERIA REMOVED.			PER CENT. OF SAMPLES CONTAINING B. COLI.	
20° C.	40° C.		20° C.	40° C.		1 c. c.	100 c. c.
	Total.	Red.		Total.	Red.		
12,000	815	295	—	—	—	100.0	100.0

Effluent from the Lawrence City Filter (Old Filter).

25	8	1	99.8	99.1	99.6	7.5	77.9
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*Average Bacterial Analyses — Concluded.**Effluent from the Lawrence City Filter (New Filter).*

BACTERIA PER CUBIC CENTIMETER.			PER CENT. OF BACTERIA REMOVED.			PER CENT. OF SAMPLES CONTAINING B. COLI.	
20° C.	40° C.		20° C.	40° C.		1 c. c.	100 c. c.
	Total.	Red.		Total.	Red.		
50	11	3	99.6	98.1	99.0	15.6	85.8

Mixed Effluents as pumped to the Distributing Reservoir.

70	8	2	-	-	-	11.7	75.9
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Water from the Outlet of the Distributing Reservoir.

73	9	2	-	-	-	1.8	70.2
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Water from a Tap at Lawrence City Hall.

28	7	1	-	-	-	0 0	50.9
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Water from a Tap at the Lawrence Experiment Station.

58	8	1	-	-	-	4.1	74.3
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INVESTIGATION ON THE EFFICIENCY OF ULTRA-VIOLET RAYS IN THE STERILIZATION OF WATER.

In January of this year an ultra-violet ray apparatus, known as Type B-2, was installed at the Lawrence Experiment Station to study the sterilization of water by ultra-violet rays. This type, with a capacity of 120 gallons per hour, was the kind installed, as it is the one recommended by the makers for use in hospitals, schools, for the army, for field construction camps, and for experimental work.

The sterilizer is made of iron, coated with enamel, and is cylindrical in shape, with outside dimensions, roughly, 10 by 15 inches. Metal cones are so constructed inside the sterilizer that the water circulates about them and comes in closest contact with the rays twice. While this type of sterilizing apparatus is generally made portable, larger units having pistol lamps, so called, are used in municipal works. The pistol lamps are entirely immersed in the water to be treated, thereby using 100 per cent. of the rays, while in Type B-2 such as is used in our experiments only 30 per cent. of the rays are said to be available;

the other 70 per cent. radiate from the top and sides of the cylinder. To obtain the highest efficiency of the rays, the water submitted to the sterilizer for treatment must be free from any solid suspended matter. Such material may not only form shadows in which the bacteria are protected, but also contain bacteria protected from the rays. We have made, therefore, experiments with waters of varying degrees of turbidity.

On January 11 Merrimack River water was delivered directly to the sterilizer at the station. One hundred and twenty gallons per hour was the maximum rate at which the sterilizer was operated, and at this rate the bactericidal action of the rays was not particularly efficient. The average turbidity of the river water during the experiment was 0.35 parts in 100,000. As recommended by the R. U. V. Company, the quartz lamp in the sterilizer was always lighted about thirty minutes before any samples were collected. This first experiment was continued for one month and the following table shows the average bacterial results:—

Average Bacterial Results.

RATE (GALLONS PER HOUR.)	RIVER WATER.			RIVER WATER AFTER RADIATION.			PER CENT. OF BACTERIA REMOVED.		
	BACTERIA PER CUBIC CENTIMETER.			BACTERIA PER CUBIC CENTIMETER.					
	4 Days, 20° C.	40° C.		4 Days, 20° C.	40° C.		4 Days, 20° C.	40° C.	
		Total.	Red.		Total.	Red.		Total.	Red.
30, ...	7,900	240	140	63	4	0	99.2	98.3	100.0
60, ...	17,000	355	210	370	20	3	97.8	94.4	98.6
90, ...	27,100	440	210	1,930	66	15	92.9	85.0	92.9
120, ...	23,700	330	175	2,440	77	29	89.7	76.7	83.4

Average B. Coli Results.

RATE (GALLONS PER HOUR.)	RIVER WATER.				RIVER WATER AFTER RADIATION.			
	PER CENT. OF SAMPLES CONTAINING B. COLI.				PER CENT. OF SAMPLES CONTAINING B. COLI.			
	.001 c. c.	.01 c. c.	0.1 c. c.	1 c. c.	0.1 c. c.	1 c. c.	10 c. c.	100 c. c.
30, ...	40.0	60.0	100	100	0.0	22.2	100	100
60, ...	33.3	55.5	100	100	6.3	56.2	100	100
90, ...	14.3	14.3	100	100	18.2	81.8	100	100
120, ...	28.6	28.6	100	100	50.0	100.0	100	100

Use of Roughing Filter.—From February 10 to March 15, inclusive, river water before being passed to the sterilizer was passed through a roughing filter to remove any suspended matter present, this filter containing about 1 foot in depth of coarse sand. At first, this filter was operated two hours a day and only when the sterilizer was running. It was observed, however, that high bacterial counts obtained in the effluent from the filter were due, as frequently happens, to a growth in the underdrains of the filter when not in operation, and, consequently, when the filter was started this growth of bacteria, etc., would be flushed out into the sterilizer in large numbers or in groups, thereby forming shadows protecting the bacteria from the bactericidal action of the rays. Hence, from March 18 to May 23, inclusive, the filter was operated continuously. Although the bacterial efficiency of the filter increased when it was operated continuously, the bactericidal action of the ultra violet rays on the resulting water was not improved.

The following table presents the average bacterial content of many samples of river water before passing through the roughing filter, and the effluent from the roughing filter before and after sterilization. The table on page 424 presents the *B. coli* results. The water delivered to the sterilizer was practically free from turbidity and low in color.

Average Bacterial Results.

February 10 to March 15, inclusive.

RATE (GALLONS PER HOUR.)	RIVER WATER.			EFFLUENT FROM ROUGHING FILTER No. 464.			EFFLUENT FROM ROUGHING FILTER No. 464 AFTER RADIATION.		
	BACTERIA PER CUBIC CENTIMETER.			BACTERIA PER CUBIC CENTIMETER.			BACTERIA PER CUBIC CENTIMETER.		
	4 Days, 20° C.	40° C.		4 Days, 20° C.	40° C.		4 Days, 20° C.	40° C.	
		Total.	Red.		Total.	Red.		Total.	Red.
30, ...	300	26	5	600	60	27	4	0	0
60, ...	2,900	99	47	2,200	46	19	52	4	0
90, ...	1,900	125	68	1,700	62	34	85	8	2
120, ...	7,100	137	82	2,600	59	35	163	6	1

March 18 to May 23, inclusive.

30, ...	1,600	76	35	31	12	0	6	4	1
60, ...	5,700	164	73	285	23	11	23	6	0
90, ...	2,150	160	111	290	15	1	38	9	1
120, ...	2,900	164	114	520	24	8	45	16	3

Average B. Coli Results.
February 10 to March 15, inclusive.

RATE (GALLONS PER HOUR.)	EFFLUENT FROM ROUGHING FILTER No. 464.				EFFLUENT FROM ROUGHING FILTER No. 464 AFTER RADIATION.			
	PER CENT. OF SAMPLES CONTAINING B. COLI.				PER CENT. OF SAMPLES CONTAINING B. COLI.			
	0.1 c. c.	1 c. c.	10 c. c.	100 c. c.	0.1 c. c.	1 c. c.	10 c. c.	100 c. c.
30, ...	100.0	100.0	100	100	0.0	0.0	0.0	100.0
60, ...	40.0	60.0	100	100	0.0	10.0	95.0	95.0
90, ...	37.5	75.0	100	100	4.2	20.8	96.0	100.0
120, ...	44.5	89.0	100	100	0.0	7.2	85.8	96.5

March 18 to May 23, inclusive.

30, ...	0.0	0.0	66.7	100	0.0	0.0	0.0	25.0
60, ...	0.0	50.0	100.0	100	0.0	4.2	58.3	79.2
90, ...	0.0	50.0	100.0	100	0.0	0.0	37.5	75.0
120, ...	25.0	33.3	100.0	100	0.0	14.6	73.0	96.0

Table showing Per Cent. Reduction of Bacteria by Radiation.

RATE (GALLONS PER HOUR.)	FEBRUARY 10 TO MARCH 15, INCLUSIVE.			MARCH 18 TO MAY 23, INCLUSIVE.		
	PER CENT. OF BACTERIA REMOVED.			PER CENT. OF BACTERIA REMOVED.		
	4 Days, 20° C.	40° C.		4 Days, 20° C.	40° C.	
		Total.	Red.		Total.	Red.
30, ...	99.3	100.0	100.0	80.7	66.7	-1
60, ...	97.6	91.3	100.0	91.9	74.0	100.0
90, ...	95.0	87.1	94.1	86.9	40.0	* 0.0
120, ...	93.7	89.8	97.1	91.3	33.3	62.5

* Increase.

More Thorough Cleaning of Apparatus. — The bacterial results so far given were obtained without frequently cleaning the sterilizer. It was not cleaned often enough, for it was observed finally that an algal growth formed a thin coating on the cone inside the sterilizer at the overflow. Hence, during the following work, the sterilizer was thoroughly cleaned before each run and flushed out as completely as possible. Special precautions were also taken by heating the interior of

the sterilizer to a high temperature while empty; that is, allowing the rays to radiate and destroy any growth adhering to the sides of the sterilizer.

The sterilizer was operated at a rate of 120 gallons per hour, and samples for bacterial analysis collected at intervals of thirty minutes. From 5 to 10 samples were included in a series, and the ultra-violet ray lamp was allowed to radiate between twenty minutes and one-half hour before the samples were collected. The results are given in the following tables, and it is evident that even under this more perfect operation the results were far from satisfactory:—

Average Bacterial Results.

SERIES NUM- BER.	RIVER WATER.			EFFLUENT FROM ROUGHING FILTER No. 464.			Number of Samples de- termined.	EFFLUENT FROM ROUGHING FILTER No. 464 AFTER RADIATION (RATE, 120 GALLONS PER HOUR).		
	BACTERIA PER CUBIC CENTIMETER.			BACTERIA PER CUBIC CENTIMETER.				BACTERIA PER CUBIC CENTIMETER.		
	4 Days, 20° C.	37° C.		4 Days, 20° C.	40° C.			4 Days, 20° C.	40° C.	
	Total.	Red.		Total.	Red.			Total.	Red.	
1, ...	1,850	78	67	730	42	30	10	338	15	6
2, ...	6,000	100	40	2,000	53	34	5	228	18	5
3, ...	6,000	114	85	2,800	120	80	5	646	38	19
4, ...	750	90	50	800	26	10	10	459	26	5
5, ...	29,000	2,520	200	1,900	380	160	8	553	159	89
6, ...	4,200	1,980	1,000	450	102	76	5	89	29	9
7, ...	1,000	510	80	540	27	12	5	94	53	22
8, ...	5,400	500	140	2,200	360	80	8	938	121	40
9, ...	4,500	380	130	1,210	360	150	5	538	102	35
10, ...	1,200	130	80	400	84	28	5	50	20	5
Average, ...	5,990	640	186	1,303	155	66	-	393	58	23

Table showing Per Cent. Reduction of Bacteria by Radiation.

SERIES NUMBER.	Number of Samples determined.	PER CENT. OF BACTERIA REMOVED.		
		4 Days, 20° C.	40° C.	
			Total.	Red.
1, ...	10	53.7	90.8	80.0
2, ...	5	88.5	68.9	85.0
3, ...	5	76.9	68.2	76.2
4, ...	10	42.6	100.0	50.0
5, ...	8	70.5	58.1	44.3
6, ...	5	80.1	71.5	88.1
7, ...	5	82.4	-1	-1
8, ...	8	57.4	63.3	50.0
9, ...	5	55.5	71.6	76.6
10, ...	5	87.5	76.0	82.0
Average, ...	-	69.5	63.1	70.2

*Average B. Coli Results.**Effluent from Roughing Filter No. 464 after Radiation.*

SERIES NUMBER.	Number of Samples determined.	PER CENT. OF SAMPLES CONTAINING B. COLI.			
		0.1 c. c.	1 c. c.	10 c. c.	100 c. c.
1, ...	10	30.0	80	100	100
2, ...	5	20.0	80	100	100
3, ...	5	0.0	100	100	100
4, ...	10	30.0	70	100	100
5, ...	8	87.5	100	100	100
6, ...	5	20.0	80	100	100
7, ...	5	80.0	100	100	100
8, ...	8	50.0	100	100	100
9, ...	5	60.0	100	100	100
10, ...	5	20.0	60	80	80
Average, ...	—	39.8	87	98	98

Treatment of Water comparatively Low in Bacteria. — It was evident from the results that the number of bacteria in the water used so far was too great for satisfactory bactericidal action by the lamp, hence, filtered water of a lower bacterial content was next experimented with.

The following results show the efficiency of ultra-violet rays in this experiment: —

Average Results of Radiation of Water Low in Bacteria and Practically Free from Turbidity.

DATE.	Num-ber of Sam-ples deter-mined.	Rate (Gallons per Hour.)	FILTERED WATER.			FILTERED WATER AFTER RADIATION.		
			BACTERIA PER CUBIC CENTIMETER.			BACTERIA PER CUBIC CENTIMETER.		
			4 Days, 20° C.	37° C.		4 Days, 20° C.	37° C.	
				Total.	Red.		Total.	Red.
1915.								
August 19, ...	5	60	175	64	24	51	18	5
October 5, ...	10	60	600	163	34	77	14	9
October 6, ...	10	60	190	27	15	39	8	3
October 22, ...	10	60	270	35	24	15	4	1
October 25, ...	10	60	1,000	40	40	19	5	1
October 26, ...	9	60	110	12	9	22	4	2
October 28, ...	10	90	600	125	125	85	18	6
October 29, ...	10	90	158	23	13	33	7	2

Average B. Coli Results.

DATE.	FILTERED WATER.					FILTERED WATER AFTER RADIATION.				
	PER CENT. OF SAMPLES CONTAINING B. COLI.					PER CENT. OF SAMPLES CONTAINING B. COLI.				
	0.01 c. c.	0.1 c. c.	1 c. c.	10 c. c.	100 c. c.	0.01 c. c.	0.1 c. c.	1 c. c.	10 c. c.	100 c. c.
1915.										
August 19, . . .	100	100	100	100	100	0	20	40	80	100
August 20, . . .	100	100	100	100	100	0	0	30	100	100
September 30, . .	0	100	100	100	100	0	0	0	100	100
October 1, . . .	0	100	100	100	100	0	0	0	100	100
October 5, . . .	0	100	100	100	100	0	0	0	100	100
October 6, . . .	0	0	0	100	100	0	0	100	100	100

DISINFECTION OF WATER BY LIQUID CHLORINE AND BLEACH.

The work along this line, started in September, 1914, was continued until July 1, 1915. Liquid chlorine was applied to the effluent from roughing Filter No. 460 until January 18 of this year, and after that liquid chlorine and bleaching powder were applied alternate weeks.

Filter No. 460 is constructed of 1 foot in depth of sand of an effective size of 0.34 millimeter over the usual underdrains. The average rate of operation was about 25,000,000 gallons per acre daily. Sand removed by scraping was replaced from time to time to maintain the original depth. The effluent from this filter is piped to the bottom of a storage tank 10 feet deep, with an overflow at the top. Liquid chlorine or bleach was passed into the effluent pipe just below a trap near the filter, and was thoroughly mixed with the water as it entered the storage tank. Storage was slightly over two hours. The amount of available chlorine used is given in the following tables. Free chlorine in the amounts added had no appreciable effect on the organic matter in the water. In the tables showing the bacterial results the samples are divided into groups according to the amount of chlorine added.

All bacterial samples of the chlorinated water were tested for free chlorine by the starch iodide test as soon as collected. The great majority of samples to which 1.5 parts or more free chlorine per million had been added contained free chlorine, while few samples to which 1 part or less had been added contained any. Intermediate samples were evenly divided between those that did and those that did not contain free chlorine. All of these tests were made about two hours after the chlorine was added. With a longer period of storage the free chlorine would tend to disappear. The amount of liquid chlorine or bleach required for a satisfactory bacterial purification of Merrimack River water after passing a roughing filter is such

that free chlorine would remain after several hours' storage of the water and possibly longer. Free chlorine from bleach seemed slightly more efficient than liquid chlorine.

Average Chemical Analyses.

Merrimack River (Canal) Water applied to Filter No. 460.

[Parts in 100,000.]

Quantity applied. Gallons per Acre Daily.	Temperature (Degrees F.).	APPEAR- ANCE.		AMMONIA.			Chlorine.	NITROGEN AS —		Oxygen consumed.	Alkalinity.
		Turbidity.	Color.	Free.	ALBUMINOID.			Nitrates.	Nitrites.		
					Total.	In Solution.					
-	43	0.3	.27	.0188	.0181	.0144	.43	.021	.0003	.59	1.4

Effluent from Roughing Filter No. 460 (before Disinfection).

25,084,000	43	0.0	.25	.0167	.0140	-	.43	.026	.0005	.52	1.6
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Effluent from Roughing Filter No. 460 (after Disinfection).

-	46	0.0	.22	.0138	.0133	-	.71	.028	.0003	.50	1.2
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Average Bacterial Analyses.

Average Parts per Million of Chlorine added.	Number of Samples averaged.	MERRIMACK RIVER WATER.			EFFLUENT FROM ROUGHING FILTER NO. 460.					
		BACTERIA PER CUBIC CENTIMETER.			BEFORE DISINFECTION.			AFTER DISINFECTION WITH LIQUID CHLORINE.		
					BACTERIA PER CUBIC CENTIMETER.			BACTERIA PER CUBIC CENTIMETER.		
		20° C.	40° C.		20° C.	40° C.		20° C.	40° C.	
			Total.	Red.		Total.	Red.		Total.	Red.
0.50	10	3,400	139	79	1,603	62	31	304	38	12
1.14	21	7,186	263	172	3,844	121	71	51	43	9
1.60	23	7,739	233	183	7,277	130	73	16	16	2
2.00	15	7,540	259	163	5,347	116	93	13	19	6
2.60	20	5,620	245	155	3,425	75	47	9	10	6
3.00	9	8,500	496	231	4,062	102	64	10	10	0.3
3.40	10	5,230	388	164	2,672	78	43	5	7	0
3.80	5	2,520	89	53	1,750	42	22	2	2	0
4.25	5	4,020	160	104	1,780	54	30	2	2	2
11.30	25	3,780	136	81	2,605	54	31	3	2	0

Average Bacterial Analyses.

Average Parts per Million of Chlorine added.	Number of Samples averaged.	MERRIMACK RIVER WATER.			EFFLUENT FROM ROUGHING FILTER NO. 460.					
		BACTERIA PER CUBIC CENTIMETER.			BEFORE DISINFECTION.			AFTER DISINFECTION WITH BLEACH.		
		40° C.			40° C.			40° C.		
		20° C.	Total.	Red.	20° C.	Total.	Red.	20° C.	Total.	Red.
1.10	14	3,386	94	47	2,065	62	31	21	17	0.4
1.60	13	2,930	233	123	1,753	78	45	21	17	1.0
2.00	9	3,466	232	71	1,864	153	38	15	14	1.2

*Average B. Coli Tests.**Effluent from Roughing Filter No. 460.*

Average Parts per Million of Chlorine added.	Number of Samples averaged.	PER CENT. OF SAMPLES CONTAINING B. COLI.							
		BEFORE DISINFECTION.			AFTER DISINFECTION WITH LIQUID CHLORINE.				
		.01 c. c.	0.1 c. c.	1 c. c.	.01 c. c.	0.1 c. c.	1 c. c.	10 c. c.	100 c. c.
0.50	10	30.0	70.0	90.0	0.0	10.0	40.0	40.0	50.0
1.14	21	29.0	48.0	81.0	0.0	10.0	19.0	22.0	29.0
1.60	23	22.0	87.0	91.0	0.0	0.0	4.0	8.0	8.0
2.00	15	33.0	87.0	93.0	0.0	0.0	0.0	0.0	7.0
2.60	20	20.0	75.0	100.0	0.0	0.0	0.0	0.0	5.0
3.00	9	38.0	88.0	100.0	0.0	0.0	0.0	0.0	0.0
3.40	10	40.0	40.0	80.0	0.0	0.0	0.0	0.0	0.0
3.80	5	0.0	60.0	60.0	0.0	0.0	0.0	0.0	0.0
4.25	5	0.0	80.0	100.0	0.0	0.0	0.0	0.0	0.0
11.30	25	12.0	56.0	84.0	0.0	0.0	0.0	0.0	0.0

*Average B. Coli Tests.**Effluent from Roughing Filter No. 460.*

Average Parts per Million of Chlorine added.	Number of Samples averaged.	PER CENT. OF SAMPLES CONTAINING B. COLI.							
		BEFORE DISINFECTION.			AFTER DISINFECTION WITH BLEACH.				
		.01 c. c.	0.1 c. c.	1 c. c.	.01 c. c.	0.1 c. c.	1 c. c.	10 c. c.	100 c. c.
1.10	14	29.0	71.0	100.0	0.0	0.0	0.0	10.0	10.0
1.60	13	30.0	61.0	92.0	0.0	0.0	0.0	8.0	8.0
2.00	9	44.4	77.7	100.0	0.0	0.0	0.0	0.0	11.1

DIVISION OF FOOD AND DRUGS.

DIVISION OF FOOD AND DRUGS.

DIRECTOR AND ANALYST, HERMANN C. LYTHGOE.

Dr. ALLAN J. McLAUGHLIN, *Commissioner of Health.*

SIR: — I have the honor to submit the following report of the Division of Food and Drugs for the year ending Nov. 30, 1915.

Respectfully,

HERMANN C. LYTHGOE,

Director and Analyst.

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REPORT OF DIVISION OF FOOD AND DRUGS.

The Division of Food and Drugs was created this year by combining the Department of Food and Drug Inspection, which consisted of the laboratory force and the food and drug inspectors, and the Department of Dairy, Cold-storage and Slaughtering Inspection. Under the former administration the secretary of the Board was the executive officer of these various departments, and directed the activities of the four food and drug inspectors. The analyst was in direct charge of the laboratory, with three assistants and one clerk. The activities of the four food and drug inspectors were directed to some extent by the secretary, but in general they traveled where and when they pleased, and submitted to the analyst and his assistants such samples as they collected.

After the analyses of these samples were made the results obtained from the adulterated samples were copied on cards which were delivered to the inspectors, who in turn gave them to the secretary, the latter passing upon the relative merits of each case and directing the inspectors to prosecute if necessary, or if not, directing that warning letters be sent, or making other disposition of the cases. Under this system the laboratory force at times was overwhelmed with work, and at other times there was but little work to be done.

The Department of Dairy, Cold-storage and Slaughtering Inspection was located in the Albion Building, 1 Beacon Street, Boston, Mass., and consisted of the supervising inspector, three cold-storage inspectors, two veterinary inspectors, three clerks and an office boy. After these departments were consolidated under one head, it was found practically impossible to operate the different sections of the Division with any degree of efficiency, owing to the fact that they were so widely separated.

An attempt was made early in the year to bring the entire Division into the State House, and accordingly the smaller laboratory in the State House was changed into an office. The dark room in the larger laboratory was removed, and the laboratory benches and assistants' desks transferred from the smaller laboratory to the larger laboratory. The larger portion of the office furniture was then removed from 1 Beacon Street to Room 501, State House, the balance being returned to the sergeant-at-arms. The Division is very much crowded in these

small quarters, but it has been promised that as soon as the bacteriological laboratory and the water laboratory are removed to their new quarters, their present quarters are to be placed at the disposal of the Food and Drug Division.

The appropriation for carrying on the work was found to be inadequate to meet the expenses regularly incurred. This deficit has been taken care of in former years by paying certain of the employees' salaries from the general appropriation. In order to avoid a deficit this year it was found essential to transfer or remove some of the employees; therefore a clerk drawing a salary of \$1,000 was transferred to another division, and her place was not filled. The resignation of one of the cold-storage inspectors drawing \$1,400 was accepted, and his position was not filled. The office of supervising inspector, at a salary of \$2,500, was abolished, and the incumbent transferred to the position of veterinary inspector at a salary of \$1,800 per annum. The saving in rent and other expenses incidental, such as telephone and electric lights, amounted to nearly \$1,000. The total saving, therefore, was \$4,100 per annum. This was not accomplished at the beginning of the year, but was developed from time to time during the year, the last change being made on the first of October. Therefore, the saving for the entire year does not equal \$4,100, but has been about \$1,700.

The large amount of money necessary to carry on the work of the Division has resulted in a deficit of about \$1,000. This has been taken from the general appropriation by employing certain of the inspectors in assisting the milk committee in making investigation which could properly be paid for out of the general appropriation.

The Division, in addition to performing the work entirely within its control, also does certain work for police departments free of charge, and for which the Legislature makes no appropriation. This work consists of making examinations of liquor samples for all police authorities and boards of health in the State, and of making examinations of poisons and turpentine for police authorities, and of paints, oils and turpentine for the Massachusetts District Police. The liquor work is, with but few exceptions, comparatively inexpensive, except on those rare occasions when the analyst is required to testify in court, and when the Department is required to make the analyses required by chapter 484 of the Acts of 1914. One such request was received this year and it was of such a nature that it was necessary to perform the work requested, which required the exclusive time of one analyst for nearly a week.

The work upon poisons is increasing rapidly and in many instances is very expensive. Certain samples are received which require the constant attention of the analyst for several days, and in many in-

stances it is necessary for the analyst to testify in court, notwithstanding the fact that the law provides that a sworn statement shall be *prima facie* evidence. These statements are never accepted in those cases which are tried in the Superior Court, and in many instances are not accepted in the lower courts.

It would seem desirable that the appropriation for the division of food inspection should be a single appropriation, instead of as at present divided in three portions. The statute relative to the appropriation for food and drug inspection provides that the Department may spend not more than \$17,500 per annum, of which three-fifths shall be spent for the enforcement of laws relative to the adulteration of milk and milk products. There is also an appropriation of \$12,000 for the cold-storage and slaughtering inspection, and an appropriation of \$3,000 for the director's salary. An appropriation of \$33,000 will be sufficient to carry on this work, and with the provision that a certain percentage of it should be spent for the enforcement of the laws relative to milk and milk products would be comparable with the present law.

The Division is in need of additional laboratory space and sufficient money for the appointment of a research assistant. Work of this nature is very difficult to perform if the analyst is interrupted to take care of routine work which, on account of the perishable nature of the samples, must be done at once. In addition to chemical research there is unusual opportunity for biological research in conjunction with milk and cold-storage work, but, in the absence of laboratory space and the necessary research assistants, such work cannot be carried on. The inspectors have brought in more samples this year than last year, and the additional work has been taken care of by making it a matter of routine. The inspectors, however, could very easily be required to increase the number of samples collected if there were more analysts to take care of the work. In case of any vacancy occurring in the inspecting force another laboratory man could be employed who would be used as an inspector in case of an emergency, or when not required in the laboratory.

The force employed at present is as follows:—

Director of Division and Chief Analyst.

HERMANN C. LYTHGOE, S.B.

Assistant Analysts.

CHARLES H. HICKEY, S.B.
LEWIS I. NURENBERG, S.B.
CLARENCE E. MARSH, A.B.
KATHERINE E. ROONEY, S.B.

Food and Drug Inspectors.

DANIEL E. MCCARTHY.
FREDERICK L. MARION.
MAURICE P. CROWE.
JAMES S. KENNEALLY.

Cold-storage Inspectors.

TOWNELEY T. FRENCH, M.D.

JOHN F. McDONOUGH.

Veterinary Inspectors.

ALVORD H. ROSE, D.V.S.

JAMES M. KINGSTON, V.M.D.

GEORGE L. DRURY, D.V.M.

Clerical.

CELESTE E. MACAULAY.

ERMYN E. SCHUMANN.

MILDRED M. LYNCH.

The law relating to cold storage states that the State Department of Health and its inspectors or employees shall have the right of entering into all cold-storage warehouses of the State. These warehouses must be licensed by the Department, and the Department has the power to revoke a license if the warehouse is in an unsanitary condition. The law also requires a report to be filed on the twenty-fifth day of January, April, July and October from each warehouse. The inspectors of the Department examine the various warehouses with reference to their sanitary condition before the licenses are issued and make several other examinations of a like nature during the year. A list of the licensed cold-storage warehouses is given in Table 17. Cold-storage articles cannot be held in storage within this State for a period longer than twelve months without the consent of the Department, and no decomposed article of food shall be placed or held in cold storage.

All requests for extension of time of storage must be investigated by the Department. If in the opinion of the inspector the article is in proper condition for storage, and the request for the extension is not exorbitant, the Department permits the extension as requested. Under the former administration all of these requests were passed upon by the Board at its monthly meetings. This at times caused a delay of nearly four weeks from the time the request was made until it was acted upon. Under the present administration the Commissioner has delegated the authority to pass upon these extensions to the director of the Division of Food and Drugs. All requests for extension are investigated by one of the cold-storage inspectors, who carefully examines the articles in question. If in the opinion of the inspector the articles are not fit for further storage, and the inspector's report is, in the opinion of the director, sufficient to warrant the action, an extension is refused. In a few instances, however, before refusing an extension chemical analyses have been made of the articles in question,

and the results of the analyses have determined the action of the director of the Division. Extensions are not granted for the entire time requested if market conditions are such that the articles can be sold in less time than is asked for in the request. Extensions are refused if the articles are not considered to be in proper condition for storage, if they have been in storage in other States before storage in Massachusetts, and if there is a good market for frozen goods at the time the extension is asked.

A large number of articles held in cold storage have been confiscated by reason of the fact that they were decomposed. In each instance the owner of the goods voluntarily released these articles to the State Department of Health. When the owner refused a release the articles were examined chemically and if found decomposed the owner was given an opportunity to show reasons why he should not be prosecuted for the sale of adulterated food. After receiving the report of the analysis the dealer, in nearly all cases, released the articles to this Department. All the samples of eggs which were confiscated had been shown to be decomposed by chemical analysis. Prosecutions were made for holding articles in storage for a period longer than twelve months without the consent of the State Department of Health, for transferring from one warehouse to another for the purpose of violating the provisions of the act, for selling cold-storage goods for fresh goods, and for the absence of the sign required by the statutes.

INSPECTION OF SLAUGHTERING.

Boards of health of all cities and towns are required to annually nominate one or more inspectors of slaughtering, who must be approved by the State Department of Health before appointment. Many of these are renominations, and if our previous year's experience showed no reason for adverse action they were approved without being specifically investigated by the inspectors of this Department. All nominees engaged in the business of slaughtering were disapproved, and, under opinions of the Attorneys-General, all members of local boards of health were disapproved.

The appointments of local inspectors of slaughtering were formerly carried out in the manner now employed for the appointment of inspectors of animals, and, in fact, the inspectors of animals were the inspectors of slaughtering. During 1909 a severe criticism was made of Massachusetts inspection of slaughtering. The Legislature requested the State Board of Health to investigate and report upon this subject, and the report submitted by the Board stated that the slaughtering laws were very generally ignored. The Legislature of 1911 passed a

new law relative to slaughtering inspection, requiring appointments to be made as outlined above. The result of this law is that there are now two inspectors for each town instead of one, but there has been some improvement in the character of local inspection. The law requires that in cities at least one inspector shall be a veterinary surgeon. Inspectors of this class naturally are more efficient than persons who have not the knowledge and experience; consequently, by reason of the larger number of confiscations made by these inspectors the slaughterers are gradually leaving the cities and carrying on their business in the small towns, where the inspectors are more liable to pass diseased carcasses than the inspectors in the city. The investigations made by the veterinary inspectors of this Department warrants the statement that in many instances the local inspector in the towns is liable not to be present at the time of slaughter, and to stamp the carcasses after they have been dressed. This is also true of some of the inspectors in the cities. This is borne out by the many instances found of slaughtering going on in the absence of the inspector. The veterinary inspectors of Boston have found carcasses on sale bearing the inspection stamp of surrounding towns, and have confiscated these carcasses by reason of the presence of hog cholera and of tuberculosis. In one of these instances the inspector who did the stamping was ignorant, and in another, the inspector was both ignorant and not present until the carcasses were ready for shipment. Illegal stamping is carried on to the greatest extent in establishments where calves are killed. The law provides that all calves weighing less than 40 pounds when dressed, with head, feet, hide and entrails removed, as well as calves less than four weeks old, shall be condemned. A number of inspectors make a practice of stamping such carcasses. This law, however, puts an unnecessary burden upon the farmer and the meat dealer. If the meat is fit for food there seems no reason why it should not be passed, whatever its age or weight, and I recommend that you request the Legislature to repeal this portion of the meat inspection laws, and permit the inspector to judge veal upon its fitness for food rather than its weight or age. The prosecutions instituted this year were for slaughtering without the inspector being present, for unlawfully using the stamp of the inspector, and for violations of the rules and regulations of the State Department of Health.

DAIRY INSPECTION.

Dairy inspection as carried out in former years has been discontinued. The hoof and mouth disease was the prime reason for so doing, but before the quarantine was removed it was decided not to

resume the work by reason of the fact that the Legislature of 1914 had made such work compulsory on the part of local boards of health, and also on account of the fact that the Milk Board of the State Department of Health was making a study of the milk situation in Massachusetts. Some dairy inspection was carried on, however, and in all 314 dairies were inspected and scored, of which number 228 were for the use of the Milk Board, and the balance were inspected at the request of local boards of health. The statistical details of these inspections have been submitted to the Milk Board for their consideration and will not be reported here.

The board of health of Provincetown requested assistance in the inspection of the dairies, and a representative of this Department visited the town and in company with the chairman of the local board of health inspected and scored 21 dairies supplying milk to Provincetown. The board of health of Holyoke requested the assistance of an inspector in examining dairies. This request was granted and the inspector visited and inspected 75 dairies supplying milk to Holyoke situated in the Connecticut valley. The board of health of Plymouth requested and received assistance in investigating a milk supply regarding which a complaint was submitted to the local board of health. The boards of health of Marlborough, Avon and Franklin requested, and received the assistance of an inspector to act as instructor to their local agents or inspectors relative to inspecting dairies. The boards of health of Winchendon, Newton and Brookline requested and received the assistance of agents of this Department upon certain of their inspection trips, as they desired the Department to have first-hand knowledge of the existing conditions. The location of the dairies visited and scored are as follows:—

Deerfield Valley, ...	82
Connecticut Valley, ...	80
Lyndonville, Vt., and vicinity, ...	44
Maine, ...	28
Springfield, Vt., and vicinity, ...	26
Berkshire County, ...	22
Truro, ...	17
Pittsfield, N. H., ...	11
Provincetown, ...	4
Total, ...	314

Chapter 744 of the Acts of 1914 clearly places the sanitary inspection and control of dairies within the jurisdiction of the local boards of

health. This act provides for the issuing of permits by the local boards after an inspection satisfactory to the board of the place in which and the circumstances under which the milk is produced, the inspection to be made by the authorized agent of the local board. These boards are given power to revoke permits if the regulations under which the permit was issued are not complied with. It is unlawful for a producer of milk or a milk dealer to sell or deliver for sale any milk without a permit. This part of the law must be enforced by the local boards as far as their local milk supply is concerned. If a permit is revoked the board must notify the State Department of Health. The State Department of Health must then inform the boards of health of cities and towns where the milk may be liable to be sold, and also must notify dealers who are liable to purchase such milk of the action of the local board of health. After receiving such a notice from the State Department of Health it is unlawful for the dealer to sell the milk. The State Department of Health must enforce the provisions of this portion of the law. The small number of communications received from the local boards of health under the provisions of this law show that either the dairies supplying milk to the citizens of this State are in excellent condition, or that the local boards of health are not enforcing the provisions of the law. The relatively few notices, however, received from local boards of health under the provisions of this act have caused a considerable amount of clerical work on the part of this Department. Sixteen cities and towns have written that they have excluded the milk of 32 different milk producers and of 2 milk dealers. The correspondence on the part of this Department relative to these notices has resulted in the sending of 196 letters to various boards of health, various producers, and to dealers who may have been liable to purchase the milk. An example of the extent of the clerical work in some instances is given in the following summary of correspondence with the board of health of Brookline relative to one producer.

On Aug. 14, 1915, Mr. Ward, agent of the Brookline board of health, notified the State Department of Health that the milk of D. C. Fletcher of Littleton was excluded from Brookline. Letters were sent to Mr. Fletcher, L. W. Bradbury, who was selling the milk, and to the boards of health of Brookline, Boston, Waltham, Newton, Somerville, Cambridge and Chelsea. On August 17 Mr. Ward of the Brookline board of health reported that Mr. Fletcher's milk was liable to be sold to Joseph L. Griffin, Vernal C. Clem, both of Jamaica Plain, and possibly to Messrs. Cossaboon and Nix of Waltham. Letters were sent to the Brookline board of health, and to Messrs. Griffin, Clem, and Cossa-

boon and Nix. On August 24 Mr. Ward wrote that Mr. Fletcher was still selling milk and violating that section of the law which the State Department of Health is required to enforce. Before this letter could be answered Mr. Ward telephoned the Department stating his willingness to assist in prosecuting Mr. Fletcher. Mr. Ward was asked over the telephone to furnish a certified copy of the permit he had issued to Mr. Fletcher and a certified copy of the order revoking the permit. This Mr. Ward stated he was unable to do, as he had never issued a permit. He stated, however, that the milk was sold to J. J. Corkery of Cambridge, who retailed it in Boston. This Department then sent a letter to Boston relative to Mr. Corkery. On September 4 Mr. Ward wrote that Mr. Fletcher's milk was being sold by John Corcoran, Union Square, Somerville. Mr. Ward again called our attention to section 2 of the act and desired our Department to follow the matter up. Section 2 of the act, however, was not being violated by Mr. Fletcher, as he never had a permit revoked. A letter was sent to Mr. Corcoran and returned to this Department unclaimed. On October 19 Mr. Ward notified the Department that as the necessary corrections had been made he had granted a permit to Mr. Fletcher. This Department then notified the following of the action of the board of health of Brookline: the boards of health of Boston, Waltham, Newton, Somerville, Cambridge, Chelsea, and Messrs. Bradbury, Griffin, Clem, and Cossaboon and Nix. This one incident resulted in 27 letters being sent from this Department to various persons and various local boards of health, and several conversations with the agent of the Brookline board of health over the telephone. The State Department of Health had no authority to prevent the sale of this milk, as a permit had never been issued to Mr. Fletcher, and, consequently, a permit could not have been revoked. The cities and towns sending such notices and the number of notices sent from each are as follows:—

Brookline, 13; Newton, 6; Holyoke, 5; Springfield, 3; 2 each from Lynn and Middleborough, and 1 each from Boston, Cambridge, Fall River, Fitchburg, Haverhill, North Adams, Quincy, Winchendon, Waltham and Somerville. One of the persons in Middleborough who was forbidden to sell milk in the town persisted in doing so and was prosecuted by the local authorities, convicted and fined.

CHEMICAL EXAMINATIONS MADE IN THE LABORATORY.

Milk.

Milk samples were collected from milk dealers in 134 cities and towns in Massachusetts, and from suspected producers in 59 cities and towns. Of the total samples collected, 4,957 were obtained from milk dealers, 1,170 from stores, 973 from suspected producers, and 134 were miscellaneous samples submitted for examination by the public, making a total number of 7,234 samples. This number is 1,226 more than the number of samples of milk collected and examined in 1914, and but for the fact that the inspectors and analysts were employed for part time during six weeks on work pertaining to the Milk Board the number of samples would have been considerably greater. Of the samples collected by the inspectors 1 per cent. was skimmed milk not properly labeled, 3 per cent. contained added water, and 10 per cent. gave reaction for pasteurized milk. Twenty-four per cent. of the total samples and 2 per cent. of the pasteurized samples were found to be below the legal standard for solids. Fewer samples were taken from suspected producers this year than during 1914. The samples so taken during 1915 were relatively higher in low standard and skimmed samples, and relatively lower in watered samples. Wherever possible and expedient milk dealers making complaints regarding their producers have been asked to submit analyses of the milk from their dairies before the inspectors have been sent to the farms. It has not been deemed desirable to examine the dairies of a milk dealer if he is known to have and to use a mixing tank, and if the average milk of his dairies is above the standard. Under these conditions the fault with the milk was assumed to be due entirely to the actions of the dealer. Warning letters were sent to dealers if the samples were simply below the standard, and in instances when second samples were obtained from these dealers and were found to be below the standard, prosecutions were instituted. The quality of the average milk sold is not so high this year as in former years, and the samples giving reactions for pasteurized milk are noticeably lower than those obtained during former years.

The following table shows the average solids, fat and solids not fat of the raw and pasteurized samples not declared adulterated during 1913, 1914 and 1915: —

YEAR.	RAW.				PASTEURIZED.			
	Number of Samples.	Solids.	Fat.	Solids not Fat.	Number of Samples.	Solids.	Fat.	Solids not Fat.
1913, ...	5,319	12.69	3.84	8.85	834	12.58	3.79	8.79
1914, ...	5,004	12.72	3.83	8.89	479	12.59	3.73	8.86
1915, ...	6,081	12.69	3.83	8.86	684	12.41	3.66	8.75

The solids, fat and solids not fat in all samples not declared adulterated during the past seven years are as follows: —

YEAR.	Number of Samples.	Solids.	Fat.	Solids not Fat.
1909, ...	4,242	12.78	4.10	8.68
1910, ...	5,032	12.85	4.02	8.83
1911, ...	4,341	12.83	4.00	8.83
1912, ...	4,516	12.66	3.89	8.77
1913, ...	6,154	12.69	3.84	8.85
1914, ...	5,502	12.70	3.82	8.88
1915, ...	6,765	12.68	3.82	8.86

The slight reduction in the average milk collected by the inspectors seemed to indicate skimming, as the solids not fat are increased, while the fat and solids are decreased. This explanation, however, is not applicable to the figures obtained from pasteurized milk. In these samples the per cent. of solids, fat and solids not fat are all decreased, which seems to indicate the purchase of relatively larger quantities of low grade milk than was formerly the practice. The usual milk statistics are found in tables 3, 4, 5, 6, 7 and 8.

Cream.

Two cream samples were found to contain added water and 4 were below the legal standard of 15 per cent. fat, and the balance of the 151 samples were found to be of good quality and free from adulteration. The 4 samples below the standard had an average fat of 11 per cent.; 30 samples were between 15 and 20 per cent. fat, average 16.6 per cent.; 31 were between 20 and 30 per cent. fat, average fat 24.7 per cent.; 55 were between 30 and 40 per cent. fat, average fat 35.3 per cent.; 31 were between 40 and 48 per cent. fat, average fat

42.8 per cent. The average of the total samples above standard was 30.9 per cent. fat; the average of the samples above 20 per cent. fat was 34.5 per cent. fat. The average of the samples above 30 per cent. fat was 38.1 per cent. fat. The average of the samples below 30 per cent. fat was 20.9 per cent. fat. There are apparently three grades of cream upon the market. A light cream with a fat content in the neighborhood of 16 per cent., a heavy cream with a fat content of 35 per cent., and a medium cream with a fat content of about 25 per cent. The retail price of cream is based upon the cream containing 40 per cent. fat, of which there were about 30 samples collected. There is in general no difference in the retail price between the various grades of heavy and medium cream. Cream is bought and sold by the dealers at prices based upon the value of the butter fat it contains. The public, however, do not get the advantage of this method of fixing the price, as the public buys by volume at a flat rate per half pint.

Condensed Milk.

Fourteen samples were examined; 2 samples reported adulterated were below the Massachusetts standard when diluted according to the label upon the package.

Butter.

One sample of renovated butter was obtained, and 1 sample of butter was rancid. The other 12 samples were found to be unadulterated.

Ice Cream.

In all 227 samples were examined, of which 11 were below the legal standard of 7 per cent. fat. The average fat of the 216 samples above 7 per cent. was 11.2 per cent., the average fat of the 116 samples above 10 per cent. was 13.7 per cent., and the average fat of the 40 samples above 15 per cent. was 17 per cent. The averages reported are substantially the same as those found in previous years. In 1913 the average of all samples above 7 per cent. was 11.9 per cent., in 1914, 11.1 per cent., and in 1915, 11.2 per cent.

Foods exclusive of Milk and Milk Products.

One thousand six hundred and ninety-three samples of food, exclusive of milk, were examined, of which 1,349 were found free from adulteration, and 344 were adulterated. The statistical summary of these analyses may be found in Table 9.

In selecting the samples for analysis particular attention is given to

those varieties of food which, on account of their nature, are subject to adulteration, and in the collection of samples those brands which experience has shown us are not liable to be adulterated are seldom purchased. The coffee and cocoa examined during the year were found to be pure. Four samples of compound coffee containing chicory were purchased. The containers stated that the contents were a mixture of coffee and chicory, but did not state the per cent. of each ingredient, as is required by the statutes.

There are no statutory standards for flavoring extracts, and in most instances we are obliged to use the dictionary in order to define the nature of the substances. In general, however, the tentative standards of the Federal authorities are followed, although these standards cannot be introduced as evidence in courts. It is an easy matter to establish a standard of purity by relying upon the past editions of the United States Pharmacopœia, but it is a difficult matter to pass upon the correct labeling of the factitious extracts, particularly the cheap lemon and orange extracts. Under our present statutes there is no way of selling these extracts unless they are labeled with the name and per cent. of each ingredient, but except alcohol and water they contain little else than a fraction of a per cent. of citral. One hundred and eighteen samples of these various extracts were examined, of which 28 lemon and 3 peppermint extracts were low in essential oil, and 20 vanilla extracts were adulterated, 8 of which bore labels stating the name but not the percentage of the ingredients, and 12 of which were mixtures of vanilla extract and solutions of vanillin sold as pure vanilla extract. These latter were the product of two firms, the manager of one of which was prosecuted and convicted, and the members of the other firm will be prosecuted early in the coming year.

The various fruit juices, except cider, were found to be sold in compliance with the law, but a large number of samples of the latter contained preservatives and were sold without the necessary label stating the name and per cent. of the added antiseptic.

Eight samples of preserved fruits were found containing benzoic acid and were not correctly labeled. One brand of soft drink (orangeade) and 11 samples of soda water contained benzoic acid. After the soda water samples were examined it was suggested to the Public Health Council that the dispensers of such beverages be permitted to place a sign in the store, rather than be compelled to label the glass, as a strict compliance of the law would require. The Council acted favorably upon this suggestion.

The samples of syrup sold as such were all pure. Nine samples of compound molasses contained glucose, the name but not the percent-

age of which was stated upon the labels. In these instances, however, the sales of the compound syrup were made when the inspector asked for molasses. One sample of compound honey was sold without a label. It was ascertained that the balance of the stock in the store was correctly labeled, and the label of the particular bottle obtained by our inspector had fallen off in the store. Seventeen samples of maple product were adulterated by the addition of cane sugar, and one sample of confectionery, almond milk chocolate, was adulterated, as it contained nuts other than almonds. The manufacturer of this product has since changed his label to comply with the requirements of the law.

A number of samples of compound lard and adulterated olive oil have been obtained, 18 of the former, and 8 of the latter. The amount of cottonseed oil in the olive oil varied from 40 to 100 per cent. All the samples of condimental sauces, pickles, spices, salad dressing and eggs were found to be unadulterated, but a number of samples of vinegar were found to be below the standard of solids or of acid.

Three hundred and fifty-four samples of meat products were examined. The samples of bacon, Hamburg steak, mince meat and veal were found free from adulteration. A large number of adulterated sausages were obtained during the year, 324 samples in all being examined. The law regarding sausages specifies that they may contain added cereal or vegetable flour to an extent of 2 per cent., but that they cannot contain any added coloring matter. The addition of water practically to any extent is permitted by the statutes. One hundred and thirteen samples were adulterated, 93 of which contained starch in excess of 2 per cent. Seventeen samples contained starch in excess of 2 per cent., and coloring matter; 3 contained coloring matter. Of the samples not declared adulterated, 138 were free from starch, and 73 contained less than 2 per cent. of starch. During December, January, February and March 39 per cent. of the total samples of sausages contained starch, 17 per cent. contained starch less than 2 per cent., and 44 per cent. contained starch in excess of 2 per cent. During October and November 45 per cent. of the total sausages contained starch; 31 per cent. showed less than 2 per cent. of starch, and 24 per cent. showed more than 2 per cent. of starch.

Three samples of fish were found to be decomposed; 2 samples of shrimp were found to be decomposed, and 10 were found to contain borax. Eighty-seven samples of scallops were examined, 34 of which contained added water, the water as a rule being put into the scallops by the persons who opened them. Four and a half gallons of scallops may be swelled by the addition of water until they become 7 gallons.

Food held in Cold Storage.

It was found necessary during the year to examine 162 samples of articles held in cold storage. Of these samples 92 were found to be decomposed and 70 were found to be normal. Sixty-two samples of frozen eggs were examined, of which 38 were found to be decomposed. Twenty-five lots of frozen eggs, representing these 38 samples and amounting to 5,231 pounds, were confiscated.

The 17 samples of butter were examined for the purpose of ascertaining whether or not they were in proper condition for further storage. The physical appearance of all these samples indicated that the articles were in good condition, but 3 of the samples were found upon analysis to be rancid and were, therefore, ordered out of storage. The samples of meat were examined for decomposition products as described in former reports, using the ammonia-nitrogen ratio as an indication of the condition of the samples. In many samples decomposition had progressed sufficiently to form trimethylamine.

The 2 samples of salmon reported were in reality one fish. This fish was representative of a large lot in storage and had been exposed for sale before being frozen, and as the season advanced and the price dropped the owner placed it in storage to hold for the following year. The physical appearance of the meat indicated that the tail ends were in good condition, while the ends near the body cavity were not. The chemical examinations showed that the portion of the fish near the body cavity was badly decomposed, while the tail pieces were in good condition. The fish were looked over by the inspectors and confiscated or not according to the physical appearance of each fish.

The statistical summary of examinations of articles held in cold storage will be found in Table 10.

Drugs.

A total of 1,141 drugs were examined, of which 173 were adulterated. The statistical summary of drugs examined will be found in Table 11.

The drug samples collected and examined are in general only those drugs which druggists are liable to make from the raw materials. Nearly all the drugs prepared by the reliable wholesale drug houses may be said to comply with the Pharmacopœia or to be up to the professed standard under which they are sold. When dealing with such articles as tincture of iodine, spirit of peppermint or spirit of anise, the findings are vastly different. These drugs are made by the simplest possible manipulation from raw materials which are nearly

always pure, and there is no reason for not preparing and dispensing full strength tinctures and spirits.

The examinations made of 944 of these drugs show a total of 148, or 15.6 per cent. of the total samples, to be below the standard required by the Pharmacopœia, the deficiency being on the average about 30 per cent. With the possible exception of spirit of nitrous ether, this adulteration is done either for fraudulent purposes or is the result of gross incompetency; and when one considers the fact that the United States Pharmacopœia gives explicit directions for keeping spirit of nitrous ether in such a manner that it will be up to the standard, the weak samples of this drug obtained by our inspectors are due to incompetency. The following table gives the results of the analyses of the adulterated samples of spirits and tinctures:—

	PER CENT. OF U. S. P. STRENGTH.										Totals.
	90.	80.	70.	60.	50.	40.	30.	20.	10.	Less than 10.	
SPIRITS.											
Anise, ...	1	7	3	2	1	1	1	1	1	1	19
Camphor, ...	—	8	2	4	1	—	1	—	1	—	17
Lemon, ...	—	—	—	—	—	—	—	1	—	—	1
Nitrous ether, ...	—	13	17	14	12	5	2	4	1	1	69
Peppermint, ...	2	8	3	4	5	1	—	3	—	—	26
TINCTURE.											
Iodine, ...	—	5	4	2	4	1	—	—	—	—	16
Totals, ...	3	41	29	26	23	11	4	9	3	2	148

The samples of alcohol submitted were found in general to be up to strength, 1 sample only, containing 82 per cent. of alcohol, being deficient. The samples of denatured and wood alcohol, with the exception of 2 samples of denatured alcohol, were properly labeled. Many samples of denatured alcohol were found to be free from methyl alcohol, and therefore did not require a poison label under our State laws.

A number of samples of aspirin tablets were obtained which were deficient in aspirin, and one of which was found to contain a foreign substance. These samples were collected late in the year and are at present under investigation.

The samples of camphor liniment examined with but two exceptions were of the strength required by the Pharmacopœia. This drug, however, is sold by the dispensatory name—camphorated oil—and the latest editions describe several different strengths.

Nine proprietary drugs were examined, one containing alcohol slightly in excess of the percentage stated upon the label, and two were headache powders upon which the name but not the percentage of acetanilid was stated.

The olive oil and anise oil samples were found to be pure, but a number of samples of citronella oil were examined in consequence of a complaint, 3 of which were found to contain alcohol. One of these adulterated samples was labeled "Mosquito Remedy," and when the inspector went a second time to obtain the official sample the pure drug was dispensed. The other samples came from one store, and the court for a technical reason refused to grant a summons for the dealer.

In response to a complaint several samples of citrate of magnesia solution were collected and found to be either pure or properly labeled.

The samples of zinc ointment were found to be up to strength, but a small number of the samples of blue ointment were found to be below the standard. The 3 samples of morphine tablets which were examined were submitted by a hospital for the purpose of ascertaining whether or not the required amount of morphine was present. The analyses showed the tablets to be of the quality designated.

Examination of Liquor for Police Authorities.

Forty-four samples of liquor were submitted by police authorities, of which 2 were below 1 per cent. and 42 above 1 per cent. in alcohol. Table 12 gives the statistical summary of the samples submitted.

The only samples of an unusual nature were 4 samples of medicine submitted by the Newton police. The results of the analyses obtained were used in the case for practicing medicine without being a duly licensed physician. The police department sent their agents, known to be in perfect health, to a medium who prescribed and furnished these highly alcoholic medicines.

Examination of Poisons for Police Authorities.

The number of samples of narcotic drugs and poisons submitted by police authorities has increased nearly 50 per cent. over those submitted last year. It is possible that the restrictions placed upon druggists by the Federal law relative to narcotic drugs has resulted in an increased sale upon the streets and possibly in the smuggling of these drugs from Canada into the United States.

The police department of Boston submitted 224 samples, the Watch and Ward Society submitted 149, and the other police authorities in this State submitted only 9 samples. It seems highly improbable that

the sale of drugs of this nature is confined to Boston, but it is possible that some police authorities prefer to submit samples to chemists doing business in their own cities or towns. The police department of Springfield submitted samples of this nature to a chemist of that city.

Of the samples submitted, 195 were pure morphine sulphate, 23 were tablets and pills containing morphine, 11 were tablets or powders containing heroin, 8 were derivatives of morphine in tablet or powder form too small in quantity for further identification, 77 were cocaine hydrochloride either in the pure state or mixed with some inert substance, and 10 were medicines containing morphine. The police of Boston, Cambridge and Haverhill each sent in a sample of alleged abortive medicine. Several alleged samples of poison were received during the year. The Boston police submitted a portion of spaghetti soup, together with a sample of rat biscuit. Both the soup and rat biscuit contained considerable quantities of arsenic. An Italian woman stated that this soup was prepared by her husband for the purpose of poisoning her. She later admitted that through jealousy she had herself placed the rat biscuit in the soup and turned the sample over to the police authorities for the purpose of implicating her husband. After making this admission she was sent away for observation.

The District Police submitted a sample of liquid found upon a prisoner which, upon examination, proved to be a solution of mercuric nitrate. The police of Beverly submitted a sample of bread mixed with a phosphorous preparation. A case relative to poisoning of hens by this preparation is at present pending in the Superior Court.

The samples of liquor submitted by the police departments of Boston, Quincy and Peabody and by the Watch and Ward Society were examined for poisons with negative results.

The statistical summary of poisons examined will be found in Table 13.

PROSECUTIONS.

The results of the cases entered into court will be found in Table 1. A total of 273 cases were entered into court, of which 225 were convicted and 28 were discharged or dismissed on motion of the inspector. The total fines imposed amounted to \$4,340.08. Of these prosecutions 169 were relative to food and drugs, 74 of which were for the sale of adulterated milk or milk below the legal standard, 72 were for the sale of adulterated foods, and 23 were for the sale of adulterated drugs. Five milk cases and 4 food cases were discharged, and 2 cases were dismissed on motion of the inspector. The total fines imposed in cases relative to milk, food and drugs were \$3,424.33. There were prosecuted

31 cases more this year than during 1914, and the amount of fines imposed was greater in 1915 by \$975.83.

Seventy prosecutions were made relative to violations of the cold-storage laws. Fifty cases were for the absence of the sign "Cold Storage Goods Sold Here," 17 for the sale of cold-storage eggs without a proper label, 2 for unlawfully returning goods to cold storage, and 1 for holding goods in storage longer than twelve months without the consent of the State Department of Health. Fifty-nine cases were convicted and 11 acquitted, the total amount of fines imposed being \$640.

Thirty-four cases were entered into court for violations of the slaughtering laws, of which 19 were for slaughtering in the absence of the inspector, 11 for the possession of unstamped meat with intent to sell the same and for selling unstamped meat, 2 for violation of the rules and regulations of the State Department of Health, and 1 each for allowing improper use of stamp and for slaughtering without a license. The total fines imposed were \$275.75.

CONFISCATIONS.

The statistical summary of confiscations of articles of food made during the year is shown in Table 2.

Nearly 11 tons of decomposed fish were confiscated by the inspectors of the Food and Drug Division, and 71,734 pounds of articles of food held in cold storage were confiscated by the cold-storage inspectors. Twenty-two thousand two hundred and fifty pounds were fish, 20,650 pounds were meat, and 18,780 pounds were poultry. Two thousand, nine hundred and twenty-seven and one-half pounds of meat were confiscated by the veterinary inspectors. These confiscations included 10 of veal, 8 of beef, and 1 of pork.

REQUESTS FOR EXTENSION OF TIME ON FOOD PRODUCTS IN COLD-STORAGE WAREHOUSES.

During the year 225 requests for extension were received from owners of articles of food held in cold storage. Of these requests 218 were granted because the articles in question were in proper condition for further storage and 7 requests were refused. Sixty-eight requests for immediate removal were granted because the articles were in proper condition for food and 1 request was refused. In this instance the substance was confiscated. The detailed summary of these extensions is given in Table 15.

QUARTERLY REPORTS OF ARTICLES IN COLD STORAGE.

The statute requires that storage warehouses shall make a report upon December 31, March 31, June 30 and September 30 of the articles of food placed in cold storage during the previous three months, and the quantity of butter and eggs held in storage on the first day of April, June, July and October. The summary of these reports is given in Table 16.

A total of about 157,000,000 pounds of food were placed in storage during the year ending September 30, of which 56,000,000 pounds were placed in storage in the spring, 46,000,000 in the summer, 35,000,000 in the winter and 25,000,000 in the fall. All classes of food appear from these reports to be stored at all seasons during the year. If monthly reports, however, were required to be submitted by the warehouses the returns would have a different significance, viz., the reports submitted show that 1,500,000 dozens of eggs were placed in storage during the quarter ending March 31, but in all probability all of these eggs were stored during March. Similarly, the reports show 544,000 dozens of eggs stored during the quarter ending December 31, and all were, undoubtedly, stored during October. It is very improbable that eggs are placed in storage during November, December, January and February, when fresh eggs are selling at such a high price. The storage of eggs begins in the spring and becomes less as the season advances. The storage of butter, like that of eggs, begins in the spring, but advances during the summer and decreases in the fall. The storage of poultry is greatest in the fall and continues during the winter, but becomes less during the spring and summer. The storage of meats is fairly uniform during the year, except in the winter time, when it is very heavy, and the storage of fish appears to be the least in the fall.

Table 16 also shows the percentage of articles stored during the various seasons of the year. These figures, calculated from the broken eggs, indicate a relatively higher amount of broken eggs stored in the summer than of whole eggs stored during the same season. This indicates that cold-storage eggs may be removed in the summer time, and such eggs as cannot be sold in the shell are broken out and replaced in the cold-storage warehouses.

NOMINATIONS OF INSPECTORS OF SLAUGHTERING BY LOCAL BOARDS
OF HEALTH.

The local boards of health made 522 nominations of inspectors of slaughtering, of which 489 were approved and 30 were disapproved by the State Department of Health. No official action was taken in 2 instances. The local boards were notified in these cases that the nominees were respectively engaged in the business of slaughtering or were members of the local board of health, and, therefore, were requested to make new nominations, as the State Department of Health could not approve of those made for the reasons given.

Of the total nominations made 80 were new nominees and their qualifications were investigated by the veterinary inspectors. The balance of the nominees had previously held the position of inspector of slaughtering and were not specifically investigated. Ten of the nominees approved have resigned and 2 have died.

REPORTS OF INSPECTORS OF SLAUGHTERING.

The law requires that the inspectors of slaughtering shall keep a record of all inspections made by them and their doings thereon, and that they shall make regular returns thereof to the State Department of Health upon prescribed forms. These reports by direction of this Department are made quarterly for the quarters ending December 31, March 31, June 30 and September 30. The compilation of the returns made is shown in Table 18.

The inspectors of 146 cities and towns in which slaughtering was done reported that there were no confiscations made during the year ending Sept. 30, 1915. In these localities there were inspected and passed 2,842 cattle, 8,521 calves, 12,861 hogs and 2,326 sheep. It seems incredible that all these animals slaughtered in these cities and towns could be in such a healthy condition that all were passed. The only other alternative is that the cattle had not been properly inspected at the time of slaughter, and that the inspector must have stamped diseased meat.

The total number of carcasses inspected was 125,283, of which 22,729 were cattle, 60,696 were calves, 34,355 were hogs and 7,953 were sheep. The total carcasses condemned were 1,585, or 1.27 per cent. of the total carcasses inspected. There were confiscated 510, or 2.29 per cent. of the cattle, 721, or 1.18 per cent. of the calves, 348, or 1.02 per cent. of the hogs and 6, or 0.08 per cent. of the sheep.

Assuming that the percentages of diseased cattle follow the laws

of probability we should expect to find one confiscation of beef in every 44 cattle slaughtered, one of calves in every 84 slaughtered, and one of hogs in every 98 slaughtered. In 82 of these 146 localities where no carcasses were confiscated, the number of animals slaughtered was insufficient to warrant, according to the above figures, the assumption of the presence of a diseased animal. If the percentage confiscations, however, are calculated from the figures submitted by those localities where confiscations have been made, the results will be a better guide to the probable number of cattle, etc., which one would expect to slaughter before a diseased carcass was found.

Recomputing upon this basis we find that there were slaughtered in those localities where confiscations were made 118,732 animals, of which 19,436 were cattle, 52,175 were calves, 21,494 were hogs and 5,627 were sheep. The per cent. of confiscated animals is as follows: Total, 1.33 per cent.; cattle, 2.63 per cent.; calves, 1.38 per cent.; hogs, 1.67 per cent.; sheep, 0.11 per cent.

Recomputing from these percentages it would be expected that 1 animal should be confiscated out of every 38 cattle, 73 calves and 80 hogs. Using these figures the inspectors in each of 60 cities probably would not be expected to find a diseased animal, but a few diseased animals may probably have been passed by some of the inspectors of those 60 towns, as among all of the animals killed in these towns one would expect a number to have been diseased. The assumption that many diseased animals are passed for food is further emphasized by the fact that the veterinary inspectors of this Department find it to be a practice in many towns for persons to slaughter in the absence of the inspector of slaughtering, who in all probability is liable to stamp meat which he has not seen slaughtered and of which he has made no inspection.

The inspectors in these 146 localities should have confiscated, according to the computation made, nearly 75 cattle, 117 calves and 215 hogs, the majority of which should have been confiscated in 86 of these localities. It is possible, however, that strictness on the part of an inspector and carefulness in purchasing on the part of a slaughterer would have a tendency to reduce the percentage confiscations in any one locality.

The following summary has been computed from Table 18, using, however, only those figures obtained from cities and towns where inspectors have made confiscations.

The prevailing cause for condemnation is tuberculosis in cattle, 2.34 per cent. being condemned for this reason; immaturity in calves, 1.21 per cent. being condemned for this reason; hog cholera in hogs,

0.66 per cent. being condemned for this reason, and tuberculosis in hogs, 0.56 per cent. being condemned for this reason.

A report to the Association of Official Agricultural Chemists by Mr. Nurenberg, assistant analyst, is included with this report and deals with the detection of added water in milk by the examination of the milk serum. The methods of preparation and examination of milk serum, now adopted as provisional by this association and now used throughout the United States, have been most extensively studied and developed in this Department, and one of the methods used was devised by an employee of this Department. It is appropriate that this article should be published as an appendix to this report.

TABLE No. 1.

Number of Complaints entered in Court.

YEAR.	Food and Other Articles (not including Milk).	Drugs.	Milk.	Total.	Convictions.	Fines imposed.
1883, ...	-	5	4	9	8	-1
1884, ...	2	1	45	48	44	-1
1885, ²	50	1	68	119	103	-1
1886, ³	10	-	10	20	19	-1
1887, ...	30	-	34	64	60	-1
1888, ...	22	-	43	65	61	\$2,042 00
1889, ...	74	-	66	140	124	3,889 00
1890, ...	78	-	24	102	96	3,919 00
1891, ...	96	5	49	150	135	2,668 00
1892, ...	52	12	72	136	123	3,661 70
1893, ...	26	3	67	96	92	2,476 00
1894, ...	14	-	76	90	77	2,625 00
1895, ...	13	11	68	92	86	2,895 30
1896, ...	7	-	68	75	74	2,812 20
1897, ...	13	1	51	65	64	2,756 60
1898, ...	10	-	54	64	62	2,060 98
1899, ...	19	2	26	47	45	1,432 66
1900, ...	45	5	44	94	89	1,890 70
1901, ...	30	-	65	95	90	1,874 70
1902, ...	25	3	48	76	74	2,617 98

¹ No record kept.

² To May 1, 1886.

³ Four months only.

Number of Complaints entered in Court — Concluded.

YEAR.	Food and Other Articles (not including Milk).	Drugs.	Milk.	Total.	Convictions.	Fines imposed.
1903, ...	34	1	44	79	70	\$1,297 66
1904, ...	6	6	50	62	57	1,509 00
1905, ...	209	27	77	313	275	8,486 00
1906, ¹	177	60	171	409	383	7,316 00
1907, ...	123	63	147	333	290	6,546 00
1908, ...	76	138	219	433	386	8,300 30
1909, ...	72	44	180	296	267	5,666 74
1910, ...	112	26	119	257	244	5,395 21
1911, ...	49	30	82	161	147	4,015 91
1912, ...	20	36	65	121	111	2,805 00
1913, ...	36	19	106 ²	161	116	2,922 75
1914, ...	44	36	58	138	114	2,438 50
1915, ...	72	23	74 ³	169	158	3,424 33

¹ Fourteen months, from Sept. 30, 1905.² One case was on account of obstruction of an inspector.³ Two cases were on account of obstruction of inspectors, and two were for assault and battery and cruelty to horse.

LIST OF PROSECUTIONS.

For Sale of Milk not of Good Standard Quality.

NAME.	Address.	Court.	Date.	Result.
Curley, George H., . . .	Chelsea, ...	Chelsea, ...	Nov. 3, 1915	Conviction.
Gisin, Isaac, ...	Springfield, . . .	Springfield, . .	June 25, 1915	Conviction.
Hood, H. P., & Sons, Inc., .	Boston, ...	Dedham, ...	May 12, 1915	Conviction. ¹
Hood, H. P., & Sons, Inc., .	Boston, ...	Somerville, . . .	May 25, 1915	Conviction. ¹
Hood, H. P., & Sons, Inc., .	Boston, ...	Chelsea, ...	May 26, 1915	Discharged.
Nichols, Harry D., . . .	Richmond, ...	Pittsfield, . . .	May 6, 1915	Conviction.
Rice, Albert A., ...	Framingham, . . .	Framingham, . .	May 15, 1915	Conviction.
Strniste, John, ...	Westfield, ...	Westfield, . . .	Dec. 8, 1914	Conviction.
Tait, Frank D., ...	Springfield, . . .	Springfield, . .	June 25, 1915	Conviction.
Yerkes, Leon J., ...	Richmond, ...	Pittsfield, . . .	May 6, 1915	Conviction.

¹ Appealed.

LIST OF PROSECUTIONS — *Continued.**For Sale of Milk from which a Portion of the Fat had been removed.*

NAME.	Address.	Court.	Date.	Result.
Burnham, Francis, . . .	Ipswich, . . .	Ipswich, . . .	Oct. 15, 1915	Conviction.
Caldwell, Brown, . . .	Stockbridge, . . .	Stockbridge, . . .	Aug. 28, 1915	Conviction.
Day, Ivory, ...	Gloucester, . . .	Gloucester, . . .	May 5, 1915	Conviction. ¹
Friedman, Samuel, . . .	Attleboro, . . .	Attleboro, . . .	July 29, 1915	Conviction.
Golart, Joseph, ...	Gloucester, . . .	Gloucester, . . .	Apr. 21, 1915	Conviction.
Graustein, William A., . .	Charlestown, . . .	Chelsea, . . .	Dec. 11, 1914	Discharged.
Klonkinota, George, . . .	Hull, ...	Hingham, . . .	Nov. 2, 1915	Conviction.
Levasseur, Ludger, . . .	New Bedford, . . .	New Bedford, . . .	Feb. 5, 1915	Conviction.
Lupo, Emanuel D., . . .	New Bedford, . . .	New Bedford, . . .	Feb. 5, 1915	Conviction.
Manley, Edward F., . . .	North Abington, . .	Abington, . . .	Apr. 22, 1915	Conviction.
McGrath, Thomas, . . .	North Abington, . .	Abington, . . .	Apr. 22, 1915	Conviction.
Merry, Charles, ...	Gloucester, . . .	Gloucester, . . .	Apr. 21, 1915	Conviction. ¹
Schmidt, Peter C., . . .	Charlestown, . . .	Chelsea, . . .	Dec. 11, 1914	Conviction. ¹
Simmons, Manuel, ...	Gloucester, . . .	Gloucester, . . .	Apr. 21, 1915	Conviction.
Stratus, Stevens, ...	Hull, ...	Hingham, . . .	Nov. 2, 1915	Conviction.
Strniste, John, ...	Westfield, ...	Westfield, . . .	Dec. 8, 1915	Conviction.
Trevoy, George C., . . .	Gloucester, . . .	Gloucester, . . .	Apr. 21, 1915	Conviction.
Williams, Joseph E., . . .	Gloucester, . . .	Gloucester, . . .	Apr. 21, 1915	Conviction.

For Sale of Milk containing Added Water.

Ardizzoni, Henry, . . .	Plymouth, . . .	Plymouth, . . .	Aug. 10, 1915	Conviction.
Bennett, Matthew J., . . .	Billerica, . . .	Lowell, . . .	July 30, 1915	Conviction. ¹
Blume, George, ...	West Acton, . . .	Concord, . . .	Apr. 20, 1915	Conviction. ¹
Bolles, George, ...	Wellesley, . . .	Dedham, . . .	June 21, 1915	Conviction.
Cameron, Daniel E., . . .	Dracut, ...	Lowell, . . .	Jan. 28, 1915	Conviction. ¹
Cameron, Daniel E., . . .	Dracut, ...	Lowell, . . .	Nov. 2, 1915	Conviction. ¹
Chemalska, Kostonly, . . .	Chelmsford, . . .	Lowell, . . .	Oct. 14, 1915	Conviction.
Day, Ivory, ...	Gloucester, . . .	Gloucester, . . .	Apr. 21, 1915	Discharged.
Dobro, Walter, ...	North Attleborough,	Attleboro, . . .	Aug. 7, 1915	Nol prossed.
Duponte, John, ...	Reading, ...	Woburn, . . .	Nov. 20, 1915	Conviction.
Elliot, W. P., ...	Lynn, ...	Lynn, ...	Jan. 16, 1915	Discharged.
Furmanick, Karl, ...	Sterling, ...	Clinton, . . .	Dec. 8, 1914	Conviction.
Gates, Llewellyn F., . . .	Westford, ...	Ayer, ...	Oct. 2, 1915	Conviction. ¹

¹ Appealed.

LIST OF PROSECUTIONS — *Continued.**For Sale of Milk containing Added Water — Concluded.*

NAME.	Address.	Court.	Date.	Result.
Goldman, Morris, . . .	Chelsea, . . .	Chelsea, . . .	Nov. 10, 1915	Conviction.
Handverger, Louis, . . .	Franklin, . . .	Franklin, . . .	Mar. 20, 1915	Conviction.
Hennessey, John, . . .	Ashby, . . .	Fitchburg, . . .	Dec. 31, 1914	Conviction.
Hoerman, Herman, . . .	North Attleborough, . . .	Attleboro, . . .	July 29, 1915	Conviction.
Jaques, George H., . . .	Methuen, . . .	Methuen, . . .	Feb. 26, 1915	Conviction.
Kashanian, Sirkis, . . .	West Andover, . . .	Lawrence, . . .	Dec. 12, 1914	Conviction.
Keene, Miles P., . . .	North Weymouth, . . .	Quincy, . . .	June 19, 1915	Conviction.
Kerepka, John, . . .	Dracut, . . .	Lowell, . . .	July 30, 1915	Conviction.
Lahti, Herman, . . .	Ashby, . . .	Ayer, . . .	Feb. 3, 1915	Conviction.
Marquis, Ephram, . . .	Blackstone, . . .	Uxbridge, . . .	July 13, 1915	Conviction.
Montenari, Louis, . . .	Plymouth, . . .	Plymouth, . . .	Aug. 28, 1915	Conviction.
Moynihan, John C., . . .	Newburyport, . . .	Newburyport, . . .	Aug. 3, 1915	Conviction.
Owen, John F., . . .	South Weymouth, . . .	Quincy, . . .	June 19, 1915	Conviction.
Perry, Frank S., . . .	Attleboro, . . .	Attleboro, . . .	Apr. 26, 1915	Conviction.
Perry, Frank S., . . .	Attleboro, . . .	Attleboro, . . .	Aug. 7, 1915	Discharged.
Phinney, Clarence, . . .	Hyannis, . . .	Barnstable, . . .	Oct. 19, 1915	Conviction. ¹
Reed, Frank, . . .	Waltham, . . .	Waltham, . . .	Aug. 3, 1915	Conviction. ¹
Rego, John, . . .	Plymouth, . . .	Plymouth, . . .	July 23, 1915	Conviction. ¹
Riley, Thomas F., . . .	Tewksbury, . . .	Lowell, . . .	June 23, 1915	Conviction.
Roderick, Joseph, . . .	Reading, . . .	Woburn, . . .	Nov. 20, 1915	Conviction.
Roper, Harry H., . . .	Ipswich, . . .	Ipswich, . . .	Oct. 15, 1915	Conviction. ¹
Schaefer, G. H., . . .	Watertown, . . .	Waltham, . . .	Jan. 1, 1915	Conviction. ¹
Schaefer, G. H., Jr., . . .	Watertown, . . .	Waltham, . . .	Jan. 1, 1915	Conviction.
Smith, Jacob, . . .	Hull, . . .	Hingham, . . .	Apr. 6, 1915	Conviction.
Sughrue, Charles, . . .	Carlisle, . . .	Lowell, . . .	May 18, 1915	Conviction.
Sullivan, Roscoe, . . .	West Springfield, . . .	Springfield, . . .	May 28, 1915	Conviction.
Willard, Emery C., . . .	Ashby, . . .	Fitchburg, . . .	Feb. 4, 1915	Conviction.
Wing, Nathaniel, . . .	Bourne, . . .	Bourne, . . .	Aug. 11, 1915	Conviction.

For Sale of Milk containing Added Foreign Matter.²

Petitt, John, . . .	North Attleborough, . . .	Attleboro, . . .	Dec. 12, 1914	Conviction. ¹
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For Sale of Ice Cream below Standard.

Todd, Henry, . . .	Nantucket, . . .	Nantucket, . . .	Aug. 19, 1915	Conviction.
Todd, Henry, . . .	Nantucket, . . .	Nantucket, . . .	Aug. 19, 1915	Conviction.

¹ Appealed.² Formaldehyde.

LIST OF PROSECUTIONS — *Continued.**For Sale of Adulterated Foods Other than Milk and Milk Products.*

CIDER.

Contained Benzoic Acid.

NAME.	Address.	Court.	Date.	Result.
Panagakis, Stra, . . .	Lynn, . . .	Lynn, . . .	Jan. 23, 1915	Conviction.

LARD.

Compound: not marked.

Amorelli, Mikel, . . .	Lawrence, . . .	Lawrence, . . .	Apr. 7, 1915	Conviction.
Bistany, Ameen, . . .	Lawrence, . . .	Lawrence, . . .	Apr. 7, 1915	Conviction.
Cutsulianos, John, . . .	Lawrence, . . .	Lawrence, . . .	Apr. 7, 1915	Conviction.
Gavin, Michael, . . .	Stoneham, . . .	Woburn, . . .	Jan. 19, 1915	Conviction.
Gavin, William, . . .	Woburn, . . .	Woburn, . . .	Jan. 19, 1915	Conviction.
Hajjar, Samuel, . . .	Lawrence, . . .	Lawrence, . . .	Nov. 18, 1915	Conviction.
Jegelwicz, Simon, . . .	Westfield, . . .	Westfield, . . .	Mar. 24, 1915	Conviction.
Kitisopandier, Mary, . . .	Springfield, . . .	Springfield, . . .	May 28, 1915	Dismissed.
Klonda, Kostontia, . . .	Lawrence, . . .	Lawrence, . . .	Apr. 7, 1915	Conviction.
Nayazbek, Noum A., . . .	Lawrence, . . .	Lawrence, . . .	Apr. 7, 1915	Conviction.
Silva, Joseph, . . .	Lawrence, . . .	Lawrence, . . .	Nov. 18, 1915	Conviction.
Silva, Maria A., . . .	Lawrence, . . .	Lawrence, . . .	Apr. 7, 1915	Conviction.

MOLASSES.

Contained Glucose.

Lindgren, John A., . . .	Gardner, . . .	Gardner, . . .	Feb. 24, 1915	Conviction.
Toolin, William E., . . .	Brookline, . . .	Brookline, . . .	Feb. 18, 1915	Conviction.
Townsend, W. J., . . .	Fitchburg, . . .	Fitchburg, . . .	Jan. 29, 1915	Conviction. ¹

OLIVE OIL.

Contained Cottonseed Oil.

Amorelli, Mikel, . . .	Lawrence, . . .	Lawrence, . . .	Apr. 7, 1915	Conviction.
Copodanna, Erasma, . . .	North Attleborough,	Attleboro, . . .	Mar. 27, 1915	Discharged.
Dailia, John, . . .	Peabody, . . .	Peabody, . . .	Apr. 30, 1915	Conviction.
Raphael, Costa, . . .	Peabody, . . .	Peabody, . . .	Apr. 30, 1915	Discharged.
Routhes, Peter, . . .	Peabody, . . .	Peabody, . . .	Apr. 30, 1915	Discharged.

¹Appealed.

LIST OF PROSECUTIONS — *Continued.**For Sale of Adulterated Foods Other than Milk and Milk Products — Continued.*

ORANGEADE.

Contained Benzoic Acid.

NAME.	Address.	Court.	Date.	Result.
Isenberg, Louis, . . .	Boston, . . .	Boston, . . .	Oct. 7, 1915	Conviction. ¹

SAUSAGE.

Contained Cereal or Vegetable Flour in Excess of 2 Per Cent.

Adamson, Frank C., . . .	Lawrence, . . .	Lawrence, . . .	Feb. 3, 1915	Conviction.
Almond, William A., . . .	New Bedford, . . .	New Bedford, . . .	Feb. 5, 1915	Conviction.
Almond, William A., . . .	New Bedford, . . .	New Bedford, . . .	Feb. 5, 1915	Conviction.
Barran, John, . . .	Fall River, . . .	Fall River, . . .	Feb. 19, 1915	Conviction.
Barran, John, . . .	Fall River, . . .	Fall River, . . .	Feb. 19, 1915	Conviction.
Bay State Packing Company,	Boston, . . .	Boston, . . .	Mar. 11, 1915	Conviction.
Bean, Robert E., . . .	Brockton, . . .	Brockton, . . .	Feb. 10, 1915	Conviction.
Butler, William A., . . .	Haverhill, . . .	Haverhill, . . .	Feb. 15, 1915	Conviction.
Close, Hubert, . . .	Pittsfield, . . .	Pittsfield, . . .	Apr. 15, 1915	Conviction.
Davidson, James, . . .	New Bedford, . . .	New Bedford, . . .	Feb. 5, 1915	Conviction.
Eberwein, John, . . .	Pittsfield, . . .	Pittsfield, . . .	Apr. 15, 1915	Conviction.
Furneau, Henry J., . . .	Lawrence, . . .	Lawrence, . . .	Feb. 3, 1915	Conviction.
Gareis, Fritz L., . . .	Brockton, . . .	Brockton, . . .	Feb. 10, 1915	Conviction.
Greenwood, Arthur, . . .	Lowell, . . .	Lowell, . . .	May 18, 1915	Conviction.
Holt, John, . . .	Lawrence, . . .	Lawrence, . . .	Feb. 3, 1915	Conviction.
Holt, John, . . .	Lawrence, . . .	Lawrence, . . .	Feb. 3, 1915	Conviction.
Holt, John, . . .	Lawrence, . . .	Lawrence, . . .	Nov. 18, 1915	Conviction.
Jegelwicz, Simon, . . .	Westfield, . . .	Westfield, . . .	Mar. 24, 1915	Conviction. ¹
Kuechler, Kurt H., . . .	New Bedford, . . .	New Bedford, . . .	Feb. 5, 1915	Conviction.
Main Provision Company, .	Boston, . . .	Lynn, . . .	Jan. 23, 1915	Conviction.
Park Sausage and Provision Company,	Boston, . . .	Boston, . . .	Mar. 18, 1915	Conviction.
Parker, Charles A., . . .	Lawrence, . . .	Lawrence, . . .	Feb. 3, 1915	Conviction.
Perkins, Daniel F., . . .	Fall River, . . .	Fall River, . . .	Feb. 19, 1915	Conviction.
Roussell, Isiae, . . .	Dracut, . . .	Lowell, . . .	May 18, 1915	Conviction.
Schmidt, Jacob H., . . .	New Bedford, . . .	New Bedford, . . .	Feb. 5, 1915	Conviction.
Weitz, Carl A., . . .	Boston, . . .	Boston, . . .	Mar. 23, 1915	Conviction.
Wigglesworth, Alfred, . . .	Holyoke, . . .	Holyoke, . . .	Nov. 16, 1915	Conviction.
Wilde, Arthur, . . .	New Bedford, . . .	New Bedford, . . .	Feb. 5, 1915	Conviction.
Wilde, Arthur, . . .	New Bedford, . . .	New Bedford, . . .	Feb. 5, 1915	Conviction.
Wilkinson, Thomas, . . .	Lawrence, . . .	Lawrence, . . .	Feb. 3, 1915	Conviction.
Zimmerman, M., Company, .	Boston, . . .	Boston, . . .	Mar. 11, 1915	Conviction.

¹ Appealed.

LIST OF PROSECUTIONS — *Continued.**For Sale of Adulterated Foods Other than Milk and Milk Products — Concluded.*SAUSAGE — *Concluded.**Contained Coloring Matter.*

NAME.	Address.	Court.	Date.	Result.
Bean, Robert E., . . .	Brockton, . . .	Brockton, . . .	Feb. 10, 1915	Conviction.
Butler, William A., . .	Haverhill, . . .	Haverhill, . . .	Feb. 15, 1915	Conviction.
Furneau, Henry J., . .	Lawrence, . . .	Lawrence, . . .	Feb. 3, 1915	Conviction.
Gareis, Fritz L., . . .	Brockton, . . .	Brockton, . . .	Feb. 10, 1915	Conviction.
Velosa, Jesse V., . . .	Fall River, . . .	Fall River, . . .	Feb. 19, 1915	Conviction. ¹
Weitz, Carl A., . . .	Boston, . . .	Boston, . . .	Nov. 23, 1915	Conviction.

SCALLOPS.

Contained Added Water.

Baker, Alton J., . . .	Dennis Port, . . .	Boston, . . .	Nov. 23, 1915	Conviction.
Cahoon, Leander, . . .	South Yarmouth, . .	Boston, . . .	Nov. 23, 1915	Conviction.
Morse, Daniel J., . . .	Boston, . . .	Boston, . . .	Nov. 23, 1915	Conviction.
Small, William C., . .	West Chatham, . .	Boston, . . .	Nov. 22, 1915	Conviction.
Tripp, Nathaniel, . . .	Dennis Port, . . .	Boston, . . .	Nov. 23, 1915	Conviction.

SHRIMP.

Decomposed.

Catalonotti, Joseph, . .	Boston, . . .	Boston, . . .	Mar. 11, 1915	Conviction.
Mantia, John, . . .	Boston, . . .	Boston, . . .	Mar. 11, 1915	Conviction.

Contained Compound of Boron.

Cassius Hunt Company, .	Boston, . . .	Boston, . . .	Mar. 30, 1915	Conviction.
Rich Company, H. A., . .	Boston, . . .	Boston, . . .	Apr. 6, 1915	Conviction.

VANILLA EXTRACT.

Contained an Alcoholic Solution of Vanillin.

Colman, Fred E., . . .	Boston, . . .	Milford, . . .	Oct. 9, 1915	Discharged.
Colman, Fred E., . . .	Boston, . . .	Natick, . . .	Oct. 9, 1915	Conviction.

¹ Appealed.

LIST OF PROSECUTIONS — *Continued.*
For Sale of Drugs Deficient in Strength.

SPIRIT OF ANISE.

NAME.	Address.	Court.	Date.	Result.
Donovan, Thomas J., . .	Salem, . . .	Salem, . . .	Mar. 19, 1915	Conviction. ¹
Gould, Orville A., . .	Gardner, . . .	Gardner, . . .	Feb. 10, 1915	Conviction.
Robillard, L. Emile, . .	Gardner, . . .	Gardner, . . .	Mar. 10, 1915	Conviction.

SPIRIT OF CAMPHOR.

Judson, George E., . .	Westfield, . . .	Westfield, . . .	Mar. 2, 1915	Conviction.
McGinty, John A., . .	Springfield, . . .	Springfield, . . .	June 25, 1915	Conviction.

SPIRIT OF NITROUS ETHER.

Cavan, Daniel J., . . .	Salem, . . .	Salem, . . .	Feb. 20, 1915	Conviction.
Crane, George E., . . .	Haverhill, . . .	Haverhill, . . .	Feb. 5, 1915	Conviction.
Fowler, Frank E., . . .	New Bedford, . . .	New Bedford, . . .	Feb. 12, 1915	Conviction.
Kilgore, Joseph W., . . .	Boston, . . .	West Roxbury, . . .	Jan. 1, 1915	Conviction.
Kimlock, William A., . . .	Salem, . . .	Salem, . . .	Feb. 11, 1915	Conviction.
Macaluso, Emanule, . . .	Boston, . . .	Boston, . . .	Mar. 11, 1915	Conviction.
Nabb, Thomas, . . .	Fall River, . . .	Fall River, . . .	Feb. 19, 1915	Conviction.
Nelson, Charles A., . . .	Haverhill, . . .	Haverhill, . . .	Feb. 15, 1915	Conviction.
Parkis, Henry H., . . .	Gardner, . . .	Gardner, . . .	Feb. 10, 1915	Conviction.
Raynsford, Charles, . . .	Clinton, . . .	Clinton, . . .	Jan. 15, 1915	Conviction.
Rourke, William, . . .	Gardner, . . .	Gardner, . . .	Feb. 10, 1915	Conviction.
St. George, Charles, . . .	Fall River, . . .	Fall River, . . .	Feb. 26, 1915	Conviction.

SPIRIT OF PEPPERMINT.

Eaton, Arthur H., . . .	Waltham, . . .	Waltham, . . .	Nov. 23, 1915	Conviction.
Hamilton, W. Allan, . . .	Boston, . . .	Dorchester, . . .	Jan. 18, 1915	Conviction.
Patterson, Darwin D., . . .	Waltham, . . .	Waltham, . . .	Nov. 23, 1915	Conviction.
Sargent, Earl L., . . .	Beverly, . . .	Salem, . . .	Mar. 19, 1915	Conviction.

TINCTURE OF IODINE.

Frost, A. T., . . .	Clinton, . . .	Clinton, . . .	Jan. 15, 1915	Conviction.
Macaluso, Emanule, . . .	Boston, . . .	Boston, . . .	Mar. 11, 1915	Conviction.

¹ Appealed.

LIST OF PROSECUTIONS — *Continued.**For Obstruction, etc.*

NAME.	Address.	Court.	Date.	Result.
Perry, Frank S., . . .	Attleboro, . . .	Attleboro, . . .	Aug. 18, 1915	Conviction. ¹
Perry, Frank S., . . .	Attleboro, . . .	Attleboro, . . .	Aug. 18, 1915	Conviction. ¹
Perry, Frank S., . . .	Attleboro, . . .	Attleboro, . . .	Aug. 18, 1915	Conviction. ^{1,2}
Perry, Frank S., . . .	Attleboro, . . .	Attleboro, . . .	Aug. 18, 1915	Conviction. ^{1,3}

*For Violation of the Laws relative to Cold Storage.*FOR HOLDING ARTICLES OF FOOD IN COLD STORAGE LONGER THAN TWELVE MONTHS
WITHOUT PERMISSION OF THE STATE DEPARTMENT OF HEALTH.

MacFarlane, Joseph J., . . .	Somerville, . . .	Boston, . . .	Oct. 21, 1915	Conviction.
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FOR UNLAWFULLY RETURNING GOODS TO COLD STORAGE.

MacFarlane, Joseph J., . . .	Somerville, . . .	Boston, . . .	Oct. 21, 1915	Conviction.
Soracco, Thomas, ...	Boston, ...	Boston, ...	Oct. 21, 1915	Conviction.

FOR ABSENCE OF A SIGN MARKED "COLD STORAGE GOODS SOLD HERE."

Alfred, Ida, ...	Lynn, ...	Lynn, ...	Jan. 8, 1915	Conviction.
Angelico, Pietro, ...	Lawrence, ...	Lawrence, ...	Dec. 30, 1914	Discharged.
Blanchard, Samuel F., ...	Brookline, ...	Brookline, ...	Jan. 18, 1915	Conviction.
Bonatakis, Victor, ...	Chicopee, ...	Chicopee, ...	Apr. 2, 1915	Discharged.
Brunell, Victor, ...	Ludlow, ...	Ludlow, ...	Apr. 2, 1915	Conviction.
Button, Sidney, ...	North Adams, ...	North Adams, ...	Mar. 26, 1915	Conviction.
Cascio, Prospero, ...	Lawrence, ...	Lawrence, ...	Dec. 30, 1914	Discharged.
Castelman, H., ...	Salem, ...	Salem, ...	Jan. 1, 1915	Conviction.
Clayton, Matthias, ...	Lawrence, ...	Lawrence, ...	Dec. 30, 1914	Conviction.
Faro, Giovanni, ...	Lawrence, ...	Lawrence, ...	Dec. 30, 1914	Discharged.
Foley, Daniel M., ...	Holyoke, ...	Holyoke, ...	Apr. 16, 1915	Conviction.
Ford, Atwood L., ...	Weymouth, ...	Quincy, ...	Jan. 6, 1915	Conviction.
Fugere & Co., Inc., ...	Salem, ...	Salem, ...	Mar. 29, 1915	Conviction.
Goodman, F., ...	Lawrence, ...	Lawrence, ...	Dec. 30, 1914	Conviction.
Green, Benjamin, ...	South Boston, ...	South Boston, ...	Apr. 27, 1915	Conviction.
Guifrida, Giovanni, ...	Lawrence, ...	Lawrence, ...	Dec. 30, 1914	Discharged.
Hadro, Ludwig, ...	Ludlow, ...	Ludlow, ...	Apr. 2, 1915	Conviction.

¹ Appealed.² Assault and battery.³ Cruelty to horse.

LIST OF PROSECUTIONS — *Continued.**For Violation of the Laws relative to Cold Storage — Continued.*FOR ABSENCE OF A SIGN MARKED "COLD STORAGE GOODS SOLD HERE" — *Concluded.*

NAME.	Address.	Court.	Date.	Result.
Kimmel, Louis, ...	Lynn, ...	Lynn, ...	Dec. 28, 1914	Conviction.
King, Oliver, ...	Adams, ...	Adams, ...	Mar. 26, 1915	Conviction.
Klein, Louis, ...	South Boston, ...	South Boston, ...	Apr. 27, 1915	Conviction.
Kronick, Simon, ...	North Adams, ...	North Adams, ...	Mar. 26, 1915	Conviction.
Long, Daniel, ...	Holyoke, ...	Holyoke, ...	Apr. 16, 1915	Conviction.
MacFarlane, Joseph J., ...	Somerville, ...	Boston, ...	Oct. 21, 1915	Conviction.
Maglia, Angelo, ...	Lawrence, ...	Lawrence, ...	Dec. 30, 1914	Discharged.
Misitz, Rosario, ...	Lawrence, ...	Lawrence, ...	Dec. 30, 1914	Discharged.
Morse, A. K., ...	Salem, ...	Salem, ...	Jan. 1, 1915	Conviction.
O'Keefe, M., Inc., ...	Boston, ...	Salem, ...	Mar. 29, 1915	Conviction.
Orcutt, Sophia M., ...	Weymouth, ...	Quincy, ...	Jan. 6, 1915	Conviction.
Parsons, C. G., ...	Salem, ...	Salem, ...	Jan. 1, 1915	Conviction.
Pattow, Eva, ...	South Boston, ...	South Boston, ...	Apr. 23, 1915	Conviction.
Perkins, Frank L., ...	Brookline, ...	Brookline, ...	Jan. 18, 1915	Conviction.
Perroni, Anoclato, ...	North Adams, ...	North Adams, ...	Mar. 26, 1915	Conviction.
Polansky, A., ...	Salem, ...	Salem, ...	Jan. 1, 1915	Conviction.
Prejsner, Wogciech, ...	Adams, ...	Adams, ...	Mar. 26, 1915	Conviction.
Puleo, Carmelo, ...	Brookline, ...	Brookline, ...	Jan. 18, 1915	Conviction.
Rourke, Patrick, Edward A. and Patrick J.	Chicopee, ...	Chicopee, ...	Apr. 2, 1915	Discharged.
Santos, Joas, ...	Ludlow, ...	Ludlow, ...	Apr. 2, 1915	Conviction.
Sfinarolakis, Michael, ...	Chicopee, ...	Chicopee, ...	Apr. 2, 1915	Discharged.
Simon, Louis, ...	North Adams, ...	North Adams, ...	Mar. 26, 1915	Conviction.
Stapleton, Eugene, ...	South Boston, ...	South Boston, ...	Apr. 23, 1915	Conviction.
Sualich, Michael, ...	South Boston, ...	South Boston, ...	Apr. 23, 1915	Conviction.
Suher, Max, ...	Holyoke, ...	Holyoke, ...	Apr. 3, 1915	Conviction.
Theofeles, John, ...	Salem, ...	Salem, ...	Jan. 1, 1915	Conviction.
Tracey, Henry J., Company,	Salem, ...	Salem, ...	Jan. 5, 1915	Discharged.
VaLeri, Francesco, ...	Lynn, ...	Lynn, ...	Jan. 1, 1915	Conviction.
Viger, John, ...	Holyoke, ...	Holyoke, ...	Apr. 16, 1915	Conviction.
Walton, Jonathan, ...	Rockland, ...	Hingham, ...	Jan. 15, 1915	Conviction.
Williams, A. C., ...	Salem, ...	Salem, ...	Jan. 1, 1915	Conviction.
Wolfenden, Robert, ...	Holyoke, ...	Holyoke, ...	Apr. 16, 1915	Conviction.
Ziembra, Walter, ...	Chicopee, ...	Chicopee, ...	Apr. 2, 1915	Conviction.

LIST OF PROSECUTIONS — *Continued.**For Violation of the Laws relative to Cold Storage — Concluded.*

FOR EXPOSING AND OFFERING COLD-STORAGE EGGS FOR SALE WITHOUT HAVING THEM PROPERLY MARKED.

NAME.	Address.	Court.	Date.	Result.
Angelico, Pietro, . . .	Lawrence, . . .	Lawrence, . . .	Dec. 30, 1914	Conviction.
Cascio, Prospero, . . .	Lawrence, . . .	Lawrence, . . .	Dec. 30, 1914	Conviction.
Castelman, H., . . .	Salem, . . .	Salem, . . .	Jan. 1, 1915	Conviction.
Clayton, Matthias, . . .	Lawrence, . . .	Lawrence, . . .	Dec. 30, 1914	Conviction.
Faro, Giovanni, . . .	Lawrence, . . .	Lawrence, . . .	Dec. 30, 1914	Conviction.
Fee, Thomas, . . .	Lynn, . . .	Lynn, . . .	Dec. 28, 1914	Conviction.
Feilteau, Hubert J., . . .	Lynn, . . .	Lynn, . . .	Dec. 28, 1914	Conviction.
Guifrida, Giovanni, . . .	Lawrence, . . .	Lawrence, . . .	Dec. 30, 1914	Conviction.
Kendall, Walter M., . . .	Attleboro, . . .	Attleboro, . . .	Jan. 28, 1915	Discharged.
Leven, William S., . . .	Brookline, . . .	Brookline, . . .	Jan. 18, 1915	Conviction.
Maglia, Angelo, . . .	Lawrence, . . .	Lawrence, . . .	Dec. 30, 1914	Conviction.
Misita, Rosario, . . .	Lawrence, . . .	Lawrence, . . .	Dec. 30, 1914	Conviction.
Parsons, C. G., . . .	Salem, . . .	Salem, . . .	Jan. 1, 1915	Conviction.
Polansky, A., . . .	Salem, . . .	Salem, . . .	Jan. 1, 1915	Conviction.
Theofeles, John, . . .	Salem, . . .	Salem, . . .	Jan. 1, 1915	Conviction.
VaLeri, Francesco, . . .	Lynn, . . .	Lynn, . . .	Jan. 1, 1915	Conviction.
Walton, Jonathan, . . .	Rockland, . . .	Hingham, . . .	Jan. 15, 1915	Conviction.

For Violation of the Laws relative to Slaughtering.

FOR SLAUGHTERING IN THE ABSENCE OF A DULY APPOINTED INSPECTOR OF SLAUGHTERING.

Broverman, Hyman, . . .	Holliston, . . .	Framingham, . . .	Jan. 26, 1915	Conviction.
Cunningham, P. W., . . .	Boxborough, . . .	Ayer, . . .	Oct. 29, 1915	Discharged.
Cunningham, Wallace F., . . .	Boxborough, . . .	Ayer, . . .	Oct. 29, 1915	Discharged.
Eaton, J. B., . . .	Peabody, . . .	Peabody, . . .	Sept. 8, 1915	Conviction.
Evans, Fred O., . . .	Randolph, . . .	Quincy, . . .	Nov. 16, 1915	Conviction.
Evans, Fred O., . . .	Randolph, . . .	Quincy, . . .	Nov. 16, 1915	Conviction.
Goldman, Max, . . .	Dudley, . . .	Webster, . . .	Oct. 28, 1915	Conviction.
Green, Abraham, . . .	Middleborough, . . .	Middleborough, . . .	Nov. 3, 1915	Conviction.
Greenfield, Max, . . .	New Lenox, . . .	Pittsfield, . . .	July 7, 1915	Conviction.
Katz, Max, . . .	North Adams, . . .	North Adams, . . .	Apr. 21, 1915	Conviction.
Katz, Max, . . .	North Adams, . . .	North Adams, . . .	Oct. 1, 1915	Conviction.
Malumphy, P. O., . . .	West Stockbridge, . . .	Lee, . . .	June 15, 1915	Conviction. ²

¹ Appealed.

LIST OF PROSECUTIONS — *Concluded.**For Violation of the Laws relative to Slaughtering — Concluded.*FOR SLAUGHTERING IN THE ABSENCE OF A DULY APPOINTED INSPECTOR OF
SLAUGHTERING — *Concluded.*

NAME.	Address.	Court.	Date.	Result.
Murphy, Edward J., . . .	Easton, . . .	Taunton, . . .	May 7, 1915	Conviction.
Nichols, Charles, . . .	Reading, . . .	Woburn, . . .	Aug. 30, 1915	Conviction.
Shapiro, Samuel, . . .	North Adams, . . .	North Adams, . . .	June 22, 1915	Dismissed.
Solomon, Philip, . . .	North Adams, . . .	North Adams, . . .	June 22, 1915	Conviction.
Winters, Reuben L., . . .	Fitchburg, . . .	Fitchburg, . . .	Oct. 30, 1915	Discharged.
Witt, Lester, . . .	Marlborough, . . .	Marlborough, . . .	Oct. 2, 1915	Conviction.
Wolf, Harry, . . .	Dudley, . . .	Webster, . . .	Oct. 28, 1915	Conviction.

FOR HAVING UNSTAMPED MEAT IN POSSESSION WITH INTENT TO SELL.

Baskin, Harry, . . .	Adams, . . .	Adams, . . .	June 30, 1915	Discharged.
Belander, Jacob, . . .	Rockport, . . .	Gloucester, . . .	Apr. 8, 1915	Conviction.
Berwick, Harry, . . .	Dudley, . . .	Webster, . . .	Nov. 22, 1915	Conviction.
Clifford, Daniel E., . . .	Ware, . . .	Ware, . . .	Aug. 28, 1915	Conviction.
Curran, Simon J., . . .	Lee, . . .	Lee, . . .	June 15, 1915	Conviction.
Eaton, J. B., . . .	Peabody, . . .	Peabody, . . .	Sept. 8, 1915	Conviction.
Gilday, John, . . .	Rowley, . . .	Newburyport, . . .	June 18, 1915	Conviction.
Nichols, Charles, . . .	Reading, . . .	Woburn, . . .	Aug. 30, 1915	Conviction.
Wheeler, Alvin, . . .	Marlborough, . . .	Marlborough, . . .	Oct. 2, 1915	Discharged.

FOR SELLING UNSPECTED AND UNSTAMPED MEAT.

Chandler, Howard, . . .	Hanson, . . .	Abington, . . .	May 5, 1915	Conviction.
Edwards, R. L., . . .	Whitman, . . .	Abington, . . .	May 5, 1915	Conviction.

FOR SLAUGHTERING WITHOUT A LICENSE.

Belander, Jacob, . . .	Rockport, . . .	Gloucester, . . .	Apr. 8, 1915	Conviction.
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AS INSPECTOR OF SLAUGHTERING, ALLOWED THE USE OF BRANDING STAMP BY ONE
OTHER THAN AN AUTHORIZED AGENT.

Eames, J. Howard, . . .	Wilmington, . . .	Woburn, . . .	Aug. 30, 1915	Conviction.
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AS INSPECTOR OF SLAUGHTERING, NEGLECTED TO COMPLY WITH THE ORDERS AND
REGULATIONS AS DIRECTED BY THE STATE DEPARTMENT OF HEALTH.

Bickford, Albert F., . . .	Randolph, . . .	Quincy, . . .	Nov. 16, 1915	Conviction.
Bickford, Albert F., . . .	Randolph, . . .	Quincy, . . .	Nov. 16, 1915	Conviction.

TABLE No. 2.

Articles in Cold Storage condemned upon Physical and Chemical Examinations as Unfit for Food.

ARTICLE.	Weight (Pounds).	Owner.
Eggs, broken out, ...	544	Brown, Morris.
Eggs, broken out, ...	800	Brown, Morris.
Eggs, broken out, ...	160	Brown, Morris.
Eggs, broken out, ...	350	Bunshaft, B.
Eggs, broken out, ...	300	Eisenberg, Joseph.
Eggs, broken out, ...	150	New York Egg and Fruit Company.
Eggs, broken out, ...	90	New York Egg and Fruit Company.
Eggs, broken out, ...	60	Pollen, Jacob.
Eggs, broken out, ...	300	Standard Egg Company.
Eggs, broken out, ...	60	Standard Egg Company.
Eggs, broken out, ...	120	Standard Egg Company.
Eggs, broken out, ...	180	Triangle Egg Company.
Eggs, broken out, ...	37	Triangle Egg Company.
Eggs, broken out, ...	780	White Star Egg and Fruit Company.
Eggs, broken out, ...	225	White Star Egg and Fruit Company.
Eggs, broken out, ...	240	White Star Egg and Fruit Company.
Eggs, broken out, ...	225	White Star Egg and Fruit Company.
Eggs, broken out, ...	120	White Star Egg and Fruit Company.
Eggs, broken out, ...	30	White Star Egg and Fruit Company.
Eggs, broken out, ...	30	White Star Egg and Fruit Company.
Eggs, broken out, ...	80	Winer, Morris.
Eggs, broken out, ...	80	Winer, Morris.
Eggs, broken out, ...	120	Winer, Morris.
Eggs, broken out, ...	60	Owner unknown.
Eggs, broken out, ...	90	Owner unknown.
Butter, ...	21	Cudahy Packing Company.
Butter, ...	3,742	Eastern Butter Company.
Butter, ...	311½	Lawrence Produce Company.
Butter, ...	356½	Lawrence Produce Company.
Butter, ...	240	Turner Centre Dairying Association.
Butter, print, ...	30	Strong, Marson Company.
Broilers, ...	27	Hanly, E. A., Company.
Broilers, ...	49	Strong, Marson Company.
Chickens, ...	34	Allen, Slade & Co.
Chickens, ...	121	Allen, Slade & Co.

Articles in Cold Storage condemned upon Physical and Chemical Examinations as Unfit for Food — Continued.

ARTICLE.	Weight (Pounds).	Owner.
Chickens, ...	74	Allen, Slade & Co.
Chickens, ...	102	Allen, Slade & Co.
Chickens, ...	5	Atwood Brothers.
Chickens, ...	110	Borst, Pierce Company.
Chickens, ...	38	Cowan Brothers.
Chickens, ...	43	Cowan Brothers.
Chickens, ...	37	Eastern Cold Storage Company.
Chickens, ...	120	Hanly, E. A., Company.
Chickens, ...	20	Humphrey, J. L.
Chickens, ...	164	Jackson & Jeffrey.
Chickens, ...	11	Jegelwicz, Simon.
Chickens, ...	290	Kimball, J. F., & Company.
Chickens, ...	2	King's Public Market Company.
Chickens, ...	211	Lawrence, J. P., & Company.
Chickens, ...	160	Lawrence, J. P., & Company.
Chickens, ...	153	Lawrence, J. P., & Company.
Chickens, ...	615	Lawrence, J. P., & Company.
Chickens, ...	187	Lawrence, J. P., & Company.
Chickens, ...	101	Morris & Company.
Chickens, ...	662	Smith Brothers.
Chickens, ...	40	Strong, Marson Company.
Chickens, ...	77	Strong, Marson Company.
Chickens, ...	38	Worcester Market.
Chickens, ...	65	Owner unknown.
Chicken breasts, ...	70	Lawrence, J. P., & Company.
Chicken breasts, ...	75	Lawrence, J. P., & Company.
Chicken breasts, ...	75	Lawrence, J. P., & Company.
Ducks, ...	34	Allen, Slade & Co.
Ducks, ...	45	Allen, Slade & Co.
Ducks, ...	110	Bannister, J. W.
Ducks, ...	176	Emerson, F. O. (estate).
Ducks, ...	775	Saunders, J. F.
Duck breasts, ...	112	Lawrence, J. P., & Company.
Fowl, ...	106	Allen, Slade & Co.
Fowl, ...	78	Allen, Slade & Co.
Fowl, ...	54	Allen, Slade & Co.

*Articles in Cold Storage condemned upon Physical and Chemical Examinations as
Unfit for Food — Continued.*

ARTICLE.	Weight (Pounds).	Owner.
Fowl, ...	210	Burns, P. L.
Fowl, ...	28	Dorr, Arthur E., & Company.
Fowl, ...	454	Hanly, E. A., Company.
Fowl, ...	105	Jackson & Jeffrey.
Fowl, ...	195	Jackson & Jeffrey.
Fowl, ...	285	Lawrence, J. P., & Company
Fowl, ...	48	Lawrence, J. P., & Company.
Fowl, ...	6	Mansfield's Market.
Fowl, ...	69	North Main Market.
Fowl, ...	220	Smith Brothers.
Fowl, ...	70	Smith Brothers.
Geese, ...	161	Bannister, J. W.
Geese, ...	245	Bannister, J. W.
Geese, ...	80	Eastern Cold Storage Company.
Geese, ...	932	Lawrence, J. P., & Company.
Geese, ...	195	Lawrence, J. P., & Company.
Geese, ...	324	Strong, Marson Company.
Guinea hens, ...	5	Strong, Marson Company.
Pigeons, ...	3	Thurston, R. M.
Roosters, ...	180	Eastern Cold Storage Company.
Roosters, ...	323	Legg, George M. D., Company.
Squab, ...	173	Lawrence, J. P., & Company.
Turkeys, ...	161	Burgess, J. M.
Turkeys, ...	382	Burns, P. L.
Turkeys, ...	26	Dorr, Arthur E., & Company.
Turkeys, ...	234	Hanly, E. A., Company.
Turkeys, ...	173	Hanly, E. A., Company.
Turkeys, ...	196	Hanly, E. A., Company.
Turkeys, ...	220	Hanly, E. A., Company.
Turkeys, ...	237	Hanly, E. A., Company.
Turkeys, ...	168	Haworth, James.
Turkeys, ...	26	Hosmer, F. H.
Turkeys, ...	5,801	Humphrey, J. L.
Turkeys, ...	25	Jones, William H., & Company.
Turkeys, ...	318	Lawrence, J. P., & Company.
Turkeys, ...	75	Smith Brothers.

*Articles in Cold Storage condemned upon Physical and Chemical Examinations as
Unfit for Food — Continued.*

ARTICLE.	Weight (Pounds).	Owner.
Turkeys, ...	93	Stevens, Genery, & Son.
Turkeys, ...	370	Wilcox, C. A., Company.
Turkeys, ...	29	Wilcox, C. A., Company.
Turkeys, ...	35	Wilcox, C. A., Company.
Miscellaneous poultry, ...	185	Allen, Slade & Co.
Miscellaneous poultry, ...	38	Allen, Slade & Co.
Miscellaneous poultry, ...	125	Scanlon, E. J., Company.
Miscellaneous poultry, ...	286	Owner unknown.
Beef, ...	41	Eastern Cold Storage Company.
Beef, ...	178	Johnson, C. L.
Beef, ...	296	Mindick, M., Co.
Beef, ...	1,059	Rounsevell, P. W.
Beef, boned, ...	456	Hawkins & Withington.
Beef, dried, ...	40	Readville Race Track.
Beef hearts, ...	175	Eastern Cold Storage.
Beef hearts, ...	586	Hawkins & Withington.
Beef hearts, ...	35	Owner unknown.
Beef livers, ...	137	Morris & Co.
Beef livers, ...	53	Shiel, Bernard F.
Beef loins, ...	28	Eastern Cold Storage Company.
Beef rumps, ...	75	Lipsky, Samuel.
Beef tenderloins, ...	63	Murphy, E. R.
Beef tops, ...	409	Boston Beef Company.
Beef trimmings, ...	1,750	Hawkins & Withington.
Beef trimmings, ...	780	Kelly, J. J., & Company.
Beef trimmings, ...	209	Lipsky, Samuel.
Beef trimmings, ...	1,915	Mindick, M., Company.
Beef trimmings, ...	12	Zimmerman, M., & Company.
Beef trimmings, ...	1,305	Zimmerman, M., & Company.
Calves' heads, ...	24	Owner unknown.
Calves' livers, ...	49	Cowan Brothers.
Calves' livers, ...	2½	King's Public Market Company.
Hams, fresh, ...	4,800	Titcomb & Co.
Hams, fresh, ...	36	Owner unknown.
Hogs' snouts, ...	1,174	Robinson, W. E.
Lamb, ...	91	Eastern States Refrigerating Company.

*Articles in Cold Storage condemned upon Physical and Chemical Examinations as
Unfit for Food — Continued.*

ARTICLE.	Weight (Pounds).	Owner.
Lamb, ...	85	Owner unknown.
Lamb fries, ...	20	Cobb, Bates & Yerxa Company.
Lamb fries, ...	135	Cudahy Packing Company.
Lamb kidneys, ...	1½	King's Public Market Company.
Lamb racks, ...	23	Eastern Cold Storage Company.
Moose meat, ...	60	Heslor, J., & Company.
Mutton, ...	41	Owner unknown.
Mutton flanks, ...	110	Eastern Cold Storage Company.
Ox tails, ...	14	Eastern Cold Storage Company.
Ox tails, ...	50	Eaton & Co.
Ox tails, ...	64	Strong, Marson Company.
Ox tails, ...	33	Strong, Marson Company.
Pigs' hearts, ...	34	Cobb, Bates & Yerxa Company.
Pigs' kidneys, ...	48	Squire, John P., & Company.
Pork, ...	180	Hawkins & Withington.
Pork, ...	47	Mello, S. P.
Pork butts, ...	50	Furneaux, Henry J.
Pork cheek meat, ...	57	Morris & Co.
Pork loins, ...	201	Boston Terminal Refrigerating Company.
Pork loins, ...	40	Owner unknown.
Pork trimmings, ...	605	Baldau, F. W.
Pork trimmings, ...	1,471	Baldau, F. W.
Pork trimmings, ...	727	Hunt, A. J., & Company.
Rabbits, ...	43	Boston Terminal Refrigerating Company.
Rabbits, ...	47	Lawrence, J. P., & Company.
Sheep plucks, ...	116	Lawrence Market Company.
Veal, ...	35	Chitoff, Isaac H.
Veal, ...	250	Cohen, Isaac.
Veal, ...	63	Saunders, J. F.
Venison, ...	36	Allen, Slade & Co.
Venison, ...	30	Eastern Cold Storage Company.
Venison, ...	28	Eastern Cold Storage Company.
Venison, ...	127	Lawrence, J. P., & Company.
Sausage, blood, ...	122	Owner unknown.
Butterfish, ...	530	Burns, John, Company.
Clams, ...	324	Atwood, D., & Company.

*Articles in Cold Storage condemned upon Physical and Chemical Examinations as
Unfit for Food — Concluded.*

ARTICLE.	Weight (Pounds).	Owner.
Flounders, ...	4,550	Schwartz & Bernstein.
Haddock, ...	545	Boston Fish Market.
Haddock, ...	464	Story-Simmons Company.
Lobster meat, ...	25	Eastern Cold Storage Company.
Lobster meat, ...	50	Massachusetts Fish and Game Commission.
Lobster meat, ...	30	Massachusetts Fish and Game Commission.
Mackerel, ...	200	Gloucester Cold Storage and Warehouse Company.
Mackerel, ...	500	Johnson, S. C., Company.
Mackerel, ...	366	Lawrence Market Company.
Mackerel, ...	132	Ocean Fish Company.
Mackerel, ...	130	Prior & Mahoney.
Mackerel, ...	1,950	Prior & Mahoney.
Mackerel, ...	54	Shedd, W. P.
Salmon, ...	60	Atlas Fish Company.
Salmon, ...	12	Eastern Cold Storage Company.
Salmon, ...	1,250	Star Fish Company.
Salmon, ...	773	Star Fish Company.
Sand eels, ...	70	Belmonte, J.
Sardine herring, ...	490	Belmonte, J.
Sardine herring, ...	1,750	Consolidated Weir Company.
Sardine herring, ...	70	Owner unknown.
Scup, ...	1,063	Darus, A.
Scup, ...	170	Mantia, Salvatore.
Scup, ...	35	Owner unknown.
Squid, ...	415	Mantia, S.
Swordfish, ...	182	Ocean Fish Company.
Miscellaneous fish, ...	3,250	Gloucester Cold Storage and Warehouse Company.
Miscellaneous fish, ...	940	Owner unknown.
Miscellaneous fish, ...	900	Owner unknown.
Miscellaneous fish, ...	745	Owner unknown.
Miscellaneous fish, ...	225	Owner unknown.

Articles of Food confiscated according to the Provisions of Acts of 1908, Chapter 329, Section 4.

ARTICLE.	Weight (Pounds).	Owner.
Fish in pickle, ...	900	Treat, Leonard.
Fish in pickle, ...	8,000	Rock, Eugene H.
Fish in pickle, ...	12,000	Rock, Eugene H.
Fish in pickle, ...	400	Rock, Eugene H.

Slaughtering Confiscations for the Year, Dec. 1, 1914, to Dec. 1, 1915.

Beef, ...	385	Broverman, Hyman.
Beef, ...	280	Katzman & Fine.
Beef, ...	251	Robbins, George L.
Beef, ...	314	Robbins, George L.
Beef, ...	254	Robbins, George L.
Beef, ...	252	Robbins, George L.
Beef, ...	244	Robbins, George L.
Beef, ...	131	Robbins, George L.
Pork, ...	185	Neelon, F. J.
Veal, ...	46	Berwick, Harry.
Veal, ...	90 $\frac{3}{4}$	Blanchard, A. F.
Veal, ...	29	Blanchard, A. F.
Veal, ...	35	Davis, Perley R.
Veal, ...	37 $\frac{3}{4}$	Green, Abraham.
Veal, ...	92	Katz, Max.
Veal, ...	30	Keller & Kremer.
Veal, ...	133	McIntire, Edward.
Veal, ...	28	Prince, S. R., Company.
Veal, ...	110	Tower, Frank E.
	2,927 $\frac{1}{2}$	

TABLE NO. 3.

Milk from Cities and Towns.

LOCALITY.	Above Stand- ard.	Below Stand- ard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk sold as Pure Milk.	Watered Milk.
Abington, ...	38	4	42	10.86	1	2	-
Acton, ...	-	10	10	9.42	-	-	10
Agawam, ...	16	14	30	10.54	-	-	-
Amesbury, ...	42	9	51	10.46	-	-	-
Amherst, ...	2	-	2	13.10	-	-	-
Andover, ...	48	19	67	9.52	-	1	4
Arlington, ...	51	21	72	9.80	1	-	-
Athol, ...	18	-	18	10.06	1	-	-
ATTLEBORO, ...	102	51	153	10.62	-	6	4
Ayer, ...	20	5	25	7.66	1	-	1
Barnstable, ...	38	15	53	10.20	-	-	5
Belmont, ...	3	-	3	12.70	-	-	-
BEVERLY, ...	43	7	50	11.64	1	-	-
Billerica, ...	14	11	25	10.08	-	-	7
Blackstone, ...	37	9	46	10.18	-	2	1
Bourne, ...	11	5	16	10.80	-	-	1
Braintree, ...	46	7	53	11.12	-	-	-
Bridgewater, ...	34	1	35	10.30	2	1	-
BROCKTON, ...	83	26	109	11.02	-	-	-
Brookfield, ...	6	1	7	12.00	-	-	-
Brookline, ...	119	25	144	9.80	1	1	-
CAMBRIDGE, ...	106	22	128	9.46	2	1	-
Canton, ...	21	6	27	11.40	-	-	-
Chelmsford, ...	6	5	11	10.34	-	-	1
CHELSEA, ...	80	10	90	10.30	-	1	2
CHICOPEE, ...	32	11	43	11.34	-	-	-
Clinton, ...	21	5	26	9.06	1	-	-
Cohasset, ...	5	1	6	11.56	-	1	-
Concord, ...	11	3	14	9.46	1	-	-
Danvers, ...	29	5	34	11.74	-	-	-
Dedham, ...	24	3	27	11.80	-	-	-
Dracut, ...	27	17	44	10.24	-	4	4
Easthampton, ...	16	2	18	11.92	-	-	-
Edgartown, ...	14	1	15	12.38	-	-	-

Milk from Cities and Towns — Continued.

LOCALITY.	Above Stand- ard.	Below Stand- ard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk sold as Pure Milk.	Watered Milk.
Essex, ...	47	25	72	11.12	-	-	-
EVERETT, ...	59	7	66	9.72	2	-	-
FALL RIVER, ...	147	28	175	10.88	-	-	2
FITCHBURG, ...	26	12	38	9.06	1	-	2
Foxborough, ...	14	2	16	12.04	-	-	-
Framingham, ...	40	8	48	9.60	1	1	-
Franklin, ...	29	6	35	11.30	-	-	-
Gardner, ...	28	8	36	11.66	-	-	-
GLOUCESTER, ...	206	65	271	9.42	-	5	10
Great Barrington, ...	19	1	20	11.50	-	-	-
Greenfield, ...	16	4	20	11.60	-	-	-
Hamilton, ...	4	-	4	12.90	-	-	-
Harwich, ...	10	5	15	10.62	-	-	-
HAVERHILL, ...	84	19	103	10.38	1	-	-
Hingham, ...	39	3	42	10.10	3	-	1
HOLYOKE, ...	32	8	40	11.80	-	-	-
Hudson, ...	20	5	25	11.00	-	2	-
Hull, ...	11	9	20	10.40	-	2	-
Ipswich, ...	58	10	68	9.58	-	2	3
LAWRENCE, ...	82	11	93	9.82	1	1	-
Lee, ...	8	2	10	9.35	2	-	-
Lenox, ...	9	1	10	11.45	-	-	-
LEOMINSTER, ...	16	2	18	11.90	-	-	-
Lexington, ...	28	3	31	11.84	-	-	-
LOWELL, ...	120	34	154	9.50	1	1	-
Ludlow, ...	13	1	14	11.74	-	-	-
LYNN, ...	96	6	102	11.54	-	-	2
Lynnfield, ...	9	3	12	11.66	-	-	-
MALDEN, ...	93	15	108	9.60	1	-	-
Manchester, ...	6	2	8	12.12	-	-	-
Mansfield, ...	14	3	17	11.28	-	-	-
Marblehead, ...	28	11	39	11.70	-	-	-
MARLBOROUGH, ...	38	4	42	11.58	-	-	-
Medfield, ...	-	2	2	12.06	-	-	-
MEDFORD, ...	80	17	97	10.88	-	-	-

Milk from Cities and Towns — Continued.

LOCALITY.	Above Stand- ard.	Below Stand- ard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk sold as Pure Milk.	Watered Milk.
MELROSE, ...	57	7	64	10.04	1	—	2
Methuen, ...	5	9	14	8.44	—	—	8
Middleborough, ...	11	1	12	11.22	—	—	1
Millbury, ...	37	14	51	9.36	1	—	—
Millis, ...	13	3	16	11.82	—	—	—
Milton, ...	9	1	10	9.46	1	1	—
Montague, ...	6	—	6	12.20	—	—	—
Nantucket, ...	45	4	49	9.52	1	—	—
Natick, ...	25	6	31	9.92	1	—	—
Needham, ...	45	8	53	11.46	—	1	—
NEW BEDFORD, ...	196	83	279	9.10	—	4	16
NEWBURYPORT, ...	40	17	57	11.10	—	1	2
NEWTON, ...	95	9	104	9.76	2	—	—
NORTH ADAMS, ...	14	—	14	12.18	—	—	—
NORTHAMPTON, ...	40	5	45	10.82	—	1	—
North Attleborough, ...	78	20	98	9.30	—	—	7
North Brookfield, ...	17	—	17	10.40	1	—	—
North Reading, ...	4	—	4	12.60	—	—	—
Norwood, ...	5	6	11	11.84	—	—	—
Oak Bluffs, ...	14	3	17	11.49	—	—	—
Orange, ...	17	1	18	12.00	—	—	—
Oxford, ...	1	1	2	9.28	1	—	—
Palmer, ...	14	1	15	11.60	—	—	—
Peabody, ...	42	3	45	11.70	—	—	—
PITTSFIELD, ...	44	15	59	11.40	—	1	—
Plymouth, ...	46	26	72	8.74	—	1	17
Provincetown, ...	10	4	14	11.54	—	—	—
QUINCY, ...	78	30	108	9.64	1	—	—
Randolph, ...	25	5	30	10.86	—	—	—
Reading, ...	19	2	21	10.52	1	—	—
REVERE, ...	66	11	77	11.04	—	—	—
Rockland, ...	32	1	33	11.74	—	—	—
Rockport, ...	18	5	23	9.90	—	—	1
SALEM, ...	32	8	40	11.64	—	—	—
Salisbury, ...	17	5	22	10.90	—	1	—

Milk from Cities and Towns — Concluded.

LOCALITY.	Above Stand- ard.	Below Stand- ard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk sold as Pure Milk.	Watered Milk.
Saugus, ...	31	10	41	11.09	-	-	4
Scituate, ...	4	-	4	13.50	-	-	-
Somerset, ...	2	-	2	12.50	-	1	-
SOMERVILLE, ...	89	26	115	11.40	-	-	-
Southbridge, ...	33	14	47	10.18	1	-	-
Spencer, ...	14	2	16	11.74	-	-	-
SPRINGFIELD, ...	78	45	123	10.54	-	2	-
Stockbridge, ...	7	3	10	10.95	-	1	-
Stoneham, ...	35	4	39	9.50	1	-	-
Stoughton, ...	26	4	30	11.72	-	-	-
Swampscott, ...	16	6	22	11.80	-	-	-
TAUNTON, ...	32	3	35	9.30	1	1	-
Templeton, ...	3	-	3	12.88	-	-	-
Uxbridge, ...	30	9	39	11.22	-	-	-
Wakefield, ...	19	3	22	11.48	-	-	-
Walpole, ...	2	-	2	12.28	-	-	-
WALTHAM, ...	83	22	105	9.38	2	-	-
Wareham, ...	13	3	16	11.18	-	-	-
Warren, ...	17	1	18	12.12	-	-	-
Watertown, ...	76	23	99	11.56	-	-	-
Webster, ...	19	10	29	9.68	2	-	-
Wellesley, ...	39	3	42	10.48	-	-	1
Westborough, ...	2	-	2	12.34	-	-	-
Westfield, ...	26	17	43	10.64	-	-	-
West Springfield, ...	15	5	20	11.60	-	-	-
Weymouth, ...	49	10	59	10.10	-	3	2
Whitman, ...	12	3	15	12.02	-	1	-
Winchendon, ...	23	-	23	12.26	-	-	-
Winchester, ...	32	5	37	11.76	-	-	-
Winthrop, ...	62	-	62	12.16	-	-	-
WOBURN, ...	77	20	97	9.84	-	1	1
WORCESTER, ...	6	8	14	11.22	-	-	-
Totals, ...	4,881	1,246	6,127	7.66	43	55	122

TABLE NO. 4.

Milk from Suspected Producers.

LOCALITY.	Above Standard.	Below Standard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk not marked.	Watered Milk.
Agawam, ...	12	6	18	11.60	4	-
Andover, ...	2	7	9	10.90	-	-
Arlington, ...	2	2	4	11.68	-	-
Ashburnham, ...	14	-	14	12.30	-	-
Ashby, ...	4	7	11	10.26	-	8
ATTLEBORO, ...	10	4	14	11.74	1	-
Ayer, ...	-	9	9	11.02	-	8
Bedford, ...	15	21	36	11.16	-	-
Billerica, ...	22	12	34	10.63	-	-
Blackstone, ...	5	7	12	10.64	-	4
Burlington, ...	1	9	10	10.78	-	-
Chelmsford, ...	24	10	34	10.92	1	6
Cohasset, ...	-	2	2	11.50	2	-
Concord, ...	1	7	8	11.24	-	-
Danvers, ...	17	9	26	11.60	-	-
Dedham, ...	6	13	19	10.90	-	-
Dover, ...	2	3	5	12.10	-	-
Dracut, ...	23	64	87	10.34	-	29
Fairhaven, ...	14	4	18	11.16	-	-
FITCHBURG, ...	11	6	17	11.78	-	-
Framingham, ...	13	2	15	11.82	-	-
Franklin, ...	3	3	6	11.50	-	3
GLOUCESTER, ...	2	6	8	10.54	2	-
Grafton, ...	3	5	8	11.52	2	-
Groton, ...	6	13	19	10.20	-	1
Ipswich, ...	27	14	41	10.60	-	1
Lexington, ...	5	11	16	11.16	-	-
LOWELL, ...	25	19	44	10.53	-	1

Milk from Suspected Producers — Concluded.

LOCALITY.	Above Standard.	Below Standard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk not marked.	Watered Milk.
Lynnfield, ...	1	4	5	10.72	-	-
Medfield, ...	1	4	5	11.14	-	-
MELROSE, ...	1	1	2	12.02	-	-
Middleton, ...	-	20	20	11.16	-	-
Millis, ...	-	7	7	11.68	-	-
Natick, ...	1	-	1	12.68	-	-
North Attleborough, ...	5	1	6	10.40	-	6
North Brookfield, ...	8	2	10	11.56	-	-
Oakham, ...	3	12	15	11.20	1	-
Pepperell, ...	6	7	13	11.48	-	-
PITTSFIELD, ...	5	-	5	12.30	-	-
Reading, ...	15	6	21	10.24	-	6
Richmond, ...	3	9	12	10.59	-	-
Rowley, ...	12	7	19	11.10	-	-
Rutland, ...	-	6	6	11.14	-	-
SALEM, ...	34	2	36	10.44	-	-
Saugus, ...	51	9	60	11.30	4	-
Sherborn, ...	9	-	9	12.60	-	-
SOMERVILLE, ...	7	4	11	11.68	-	-
SPRINGFIELD, ...	9	20	29	10.44	-	3
Stoneham, ...	2	4	6	11.04	-	-
Tewksbury, ...	-	8	8	9.64	-	2
Wakefield, ...	10	19	29	10.86	-	-
WALTHAM, ...	-	5	5	7.24	-	5
Wellesley, ...	7	2	9	10.86	-	9
Westborough, ...	3	-	3	13.48	-	-
Westfield, ...	2	2	4	11.56	-	-
Westford, ...	3	4	7	8.94	-	4
West Springfield, ...	2	8	10	9.80	-	8
Weymouth, ...	23	13	36	10.83	-	10
WOBURN, ...	4	16	20	11.68	-	-
Totals, ...	496	477	973	7.24	17	114

TABLE NO. 5.

Summary of Milk Statistics.

MILK.	Above Stand-ard.	Below Stand-ard.	Total.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk not marked.	Watered Milk.
Milk from cities and towns, .	4,881	1,246	6,127	7.66	43	55	122
Milk from suspected producers.	496	477	973	7.24	-	17	114
Miscellaneous milk samples, .	118	16	134	11.64	1	2	1
Totals, ...	5,495	1,739	7,234	7.24	44	74	237

TABLE NO. 6.

Summary of Milk Statistics by Months.¹

MONTH.	Number above Stand-ard.	Number below Stand-ard.	Total Samples collected.	Skimmed Samples marked.	Skimmed Samples not marked.	Watered Samples.	Pasteurized Samples.	Pasteurized Samples below Standard.	Per Cent. of Skimmed Samples not marked.	Per Cent. of Watered Samples.	Per Cent. of Pasteurized Samples.	Per Cent. of Pasteurized Samples below Stand-ard.	Per Cent. of Total Samples below Standard.
1914.													
December, ...	256	62	318	3	1	21	43	2	0.31	0.66	13.5	0.63	19.5
1915.													
January, ...	207	57	264	-	4	3	21	4	1.52	1.14	7.96	1.52	21.6
February, ...	475	115	590	5	6	12	69	4	1.02	2.03	11.70	0.68	19.5
March, ...	502	152	654	3	12	33	71	8	1.83	5.05	10.85	1.22	23.2
April, ...	498	218	716	6	8	5	64	30	1.12	0.70	8.94	4.19	30.4
May, ...	676	207	883	1	9	25	118	16	1.02	2.83	13.40	1.81	23.4
June, ...	553	174	727	6	4	8	65	10	0.55	1.10	8.93	1.37	23.9
July, ...	448	264	712	2	11	63	107	40	1.55	8.85	15.00	5.62	37.1
August, ...	336	141	477	4	9	21	19	9	1.89	4.40	3.99	1.89	29.6
September, ...	346	152	498	4	3	19	37	8	0.60	3.82	7.44	1.61	30.5
October, ...	509	96	605	1	6	4	28	7	0.99	0.66	4.63	1.16	15.9
November, ...	580	95	675	9	1	23	54	9	0.15	3.41	8.00	1.33	14.1
Totals, ...	5,386	1,733	7,119	44	74	237	696	147	1.04	3.33	9.77	2.10	24.3

¹ Includes samples collected by inspectors only.

TABLE No. 7.

Quality of Milk by Months.¹

MONTH.	NUMBER OF SAMPLES WITH SOLIDS VARYING BETWEEN —									Totals.
	15 Per Cent. and above.	14 and 15 Per Cent.	13 and 14 Per Cent.	12.15 and 13 Per Cent.	11 and 12.15 Per Cent.	10 and 11 Per Cent.	9 and 10 Per Cent.	8 and 9 Per Cent.	7.66 and 8 Per Cent.	
1914.										
December, ...	3	17	73	161	57	5	2	—	—	318
1915.										
January, ...	7	8	65	127	53	2	2	—	—	264
February, ...	3	22	126	323	99	6	9	2	—	590
March, ...	9	23	143	325	126	19	9	—	—	654
April, ...	3	20	125	345	206	13	4	—	—	716
May, ...	6	13	164	502	193	14	1	—	—	883
June, ...	6	14	128	401	165	8	4	—	1	727
July, ...	5	18	119	306	214	33	11	5	1	712
August, ...	5	17	108	204	125	14	3	1	—	477
September, ...	5	17	87	234	132	18	4	1	—	498
October, ...	3	22	160	323	91	2	4	—	—	605
November, ...	12	26	202	335	81	12	7	—	—	675
Totals, ...	67	217	1,490	3,586	1,542	146	60	9	2	7,119

¹ Includes samples collected by inspectors only.

TABLE No. 8.

Quality of Average Milk by Months.

MONTH.	AVERAGE OF ALL SAMPLES.			Number.	AVERAGE OF ALL SAMPLES NOT DECLARED SKIMMED OR WATERED.			Number.	AVERAGE OF RAW SAMPLES NOT DECLARED SKIMMED OR WATERED.			Number.	AVERAGE OF PASTEURIZED SAMPLES NOT DECLARED SKIMMED OR WATERED.			
	Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).		Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).		Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).					
1914.																
December,	318	12.63	3.73	8.90	293	12.75	3.77	8.98	250	12.76	3.78	8.98	43	12.63	3.64	8.99
1915.																
January,	264	12.68	3.76	8.92	257	12.73	3.80	8.93	236	12.74	3.81	8.93	21	12.62	3.76	8.96
February,	590	12.57	3.76	8.81	567	12.67	3.80	8.87	500	12.68	3.82	8.86	67	12.68	3.74	8.94
March,	654	12.60	3.76	8.84	606	12.73	3.82	8.91	537	12.78	3.85	8.93	69	12.35	3.62	8.73
April,	716	12.46	3.69	8.77	697	12.51	3.74	8.77	637	12.55	3.76	8.79	60	12.19	3.56	8.63
May,	883	12.52	3.78	8.74	848	12.69	3.85	8.84	732	12.76	3.88	8.88	116	12.24	3.64	8.80
June,	727	12.50	3.74	8.76	710	12.56	3.78	8.78	646	12.57	3.79	8.78	64	12.44	3.70	8.74
July,	712	12.31	3.72	8.59	636	12.55	3.80	8.75	529	12.59	3.83	8.76	107	12.34	3.73	8.61
August,	477	12.55	3.84	8.71	443	12.68	3.93	8.75	424	12.69	3.94	8.75	19	12.32	3.70	8.62
September,	498	12.45	3.76	8.69	472	12.56	3.83	8.73	436	12.56	3.84	8.72	36	12.45	3.66	8.79
October,	605	12.69	3.75	8.94	594	12.74	3.78	8.96	566	12.75	3.79	8.96	28	12.45	3.60	8.85
November,	675	12.79	3.80	8.99	642	12.91	3.87	9.04	588	12.93	3.89	9.04	54	12.66	3.64	9.02
Totals,	7,119	12.55	3.76	8.79	6,765	12.68	3.82	8.86	6,081	12.69	3.83	8.86	684	12.41	3.66	8.75

TABLE No. 9.

Summary of Statistics of Food exclusive of Milk.

CHARACTER OF SAMPLE.	Genuine.	Adulterated.	Totals.	CHARACTER OF SAMPLE.	Genuine.	Adulterated.	Totals.
Bakers' supplies, ...	16	-	16	Honey, ...	8	1	9
Baking powder, ...	3	-	3	Horse-radish, ...	2	-	2
Bread, ...	13	-	13	Ice cream, ...	216	11	227
Butter, ...	10	2	12	Jams and jellies, ...	40	8	48
Canned goods, ...	8	-	8	Lard, ...	57	18	75
Cheese, ...	1	-	1	Maple sugar, ...	80	13	93
Cider, ...	7	9	16	Maple syrup, ...	10	4	14
Clam juice, ...	1	-	1	Meat products: —			
Cocoa, ...	28	-	28	Bacon, ...	1	-	1
Coffee and compound coffee, .	3	4	7	Hamburg steak, ...	18	-	18
Condensed milk, ...	12	2	14	Mince meat, ...	9	-	9
Condimental sauces, ...	13	-	13	Sausages, ...	211	113	324
Confectionery, ...	28	1	29	Veal, ...	2	-	2
Cooking fat, ...	1	-	1	Molasses, ...	52	9	61
Cream, ...	145	6	151	Oil of sweet almond, ...	3	-	3
Cream of tartar, ...	11	-	11	Olive oil, ...	41	8	49
Eggs, ...	26	-	26	Pickles, ...	6	-	6
Fish, ...	10	3	13	Root beer extract, ...	2	-	2
Fish paste, ...	1	-	1	Salad dressing, ...	5	-	5
Flavoring extracts: —				Scallops, ...	53	34	87
Almond, ...	1	-	1	Shredded cocoanut, ...	1	-	1
Lemon, ...	31	28	59	Shrimp, ...	17	12	29
Peppermint, ...	6	3	9	Soda water syrups, ...	18	11	29
Pineapple, ...	2	-	2	Soft drinks, ...	9	2	11
Vanilla, ...	26	20	46	Spices, ...	37	-	37
Wintergreen, ...	1	-	1	Syrups, ...	5	-	5
Flour, ...	4	-	4	Tomato soup, ...	1	-	1
Frosting, ...	5	-	5	Vinegar, ...	24	22	46
Fruit juices: —				Totals, ...	1,349	344	1,693
Cranberry, ...	1	-	1				
Grape, ...	1	-	1				
Lime, ...	6	-	6				

TABLE NO. 10.

Summary of Examination of Articles of Food held in Cold Storage.

CHARACTER OF SAMPLE.	Good.	Bad.	Totals.	CHARACTER OF SAMPLE.	Good.	Bad.	Totals.
Butter, ...	14	3	17	Poultry — <i>Con.</i>			
Eggs, ...	27	38	65	Duck, ...	—	1	1
Meat: —				Fowl, ...	6	5	11
Beef trimmings, ...	—	5	5	Geese, ...	—	2	2
Hams, ...	—	4	4	Rooster, ...	1	—	1
Pork cheeks, ...	3	1	4	Turkeys, ...	—	5	5
Pork loins, ...	2	—	2	Salmon, ...	1	1	2
Pork trimmings, ...	12	18	30	Totals, ...	70	92	162
Poultry: —							
Chickens, ...	4	9	13				

TABLE NO. 11.

Summary of Drug Statistics.

CHARACTER OF SAMPLE.	Genuine.	Adulterated.	Totals.	CHARACTER OF SAMPLE.	Genuine.	Adulterated.	Totals.
Alcohol, ...	23	1	24	Precipitated sulphur, ...	1	—	1
Aspirin tablets, ...	9	6	15	Proprietary drugs, ...	6	3	9
Bay rum, ...	—	1	1	Sodium bicarbonate, ...	1	—	1
Borax, ...	1	—	1	Sodium borate, ...	1	—	1
Camphor liniment, ...	13	2	15	Solution of magnesium citrate, ...	6	—	6
Denatured alcohol, ...	32	2	34	Spirit of: —			
Essence of pepsin, ...	1	—	1	Anise, ...	59	19	78
Glycerine, ...	1	—	1	Camphor, ...	150	17	167
Hamamelis water, ...	8	—	8	Gaultheria, ...	17	—	17
Lime water, ...	—	1	1	Lemon, ...	—	1	1
Methyl alcohol, ...	1	—	1	Nitrous ether, ...	130	69	199
Morphine tablets, ...	3	—	3	Peppermint, ...	253	26	279
Oils: —				Tincture of: —			
Anise, ...	1	—	1	Ginger, ...	4	—	4
Citronella, ...	25	3	28	Iodine, ...	179	16	195
Olive, ...	5	—	5	Iron, ...	1	—	1
Ointments: —				Myrrh, ...	1	—	1
Mercurial and blue, ...	22	6	28	Rhubarb, ...	1	—	1
Zinc oxide, ...	13	—	13	Totals, ...	968	173	1,141

Summary of Liquor Statistics.

LOCALITY.	Beer.	Cider.	Wine.	Distilled Liquors.	Miscellaneous and Remarks.	Totals.
Arlington, ...	-	2	-	-	- -	2
BEVERLY, ...	-	2	2	2	- -	6
BOSTON, ...	1	-	3	-	1 (punch), ...	5
CAMBRIDGE, ...	-	-	1	-	- -	1
Canton, ...	-	-	-	-	1 (Jamaica Ginger), ...	1
LAWRENCE, ...	1	1	-	-	- -	2
LYNN, ...	-	-	1	4	- -	5
Mansfield, ...	-	2	2	-	- -	4
Middleborough, ...	-	1	-	-	- -	1
Middleton, ...	-	1	-	-	- -	1
NEWTON, ...	-	-	-	-	4 (samples of medicine), ...	4
Norwood, ...	-	1	-	-	- -	1
Peabody, ...	-	1	-	-	- -	1
REVERE, ...	-	2	-	-	- -	2
SALEM, ...	-	-	-	-	1 - -	1
SOMERVILLE, ...	-	-	3	1	- -	4
Stoneham, ...	-	1	-	-	- -	1
Wellesley, ...	-	1	-	-	- -	1
Wrentham, ...	-	1	-	-	- -	1
Totals, ...	2	16	12	7	7 - -	44

Summary of Poison Statistics.

[illegible]

Summary of Poison Statistics — Concluded.

CHARACTER OF SAMPLE.	Boston Police.	Beverly Police.	Cambridge Police.	Dedham Police.	Haverhill Police.	Peabody Police.	Quincy Police.	State Police.	Watch and Ward Society.	Totals.
Heroin, ...	3	-	-	-	-	-	-	-	-	3
Heroin tablets, ...	8	-	-	-	-	-	-	-	-	8
Gum opium, ...	7	-	-	-	-	-	-	-	1	8
Opium ash, ...	9	-	-	-	-	-	-	-	-	9
Cocaine hydrochloride, ...	30	-	-	-	-	-	-	-	47	77
Cocaine, ...	1	-	-	-	-	-	-	-	1	2
Tablets, etc., containing no alkaloids, ...	19	-	-	1	-	-	-	-	5	25
Abortion medicines, ...	1	-	1	-	1	-	-	-	-	3
Suspected poisons (found), ...	2	1	-	-	-	-	-	-	-	3
Suspected poisons (not found), ...	4	-	-	-	-	1	1	1	1	8
Totals, ...	224	1	2	1	2	1	1	1	149	382

TABLE NO. 14.

General Summary.

	Legal.	Illegal.	Totals.
Milk, ...	5,495	1,739	7,234
Foods, exclusive of milk, ...	1,349	344	1,693
Drugs, ...	968	173	1,141
Totals, ...	7,812	2,256	10,068
Cold-storage goods, ...	70	92	162
Poisons, ...	35	347	382
Liquors, ...	2	42	44
Totals, ...	7,919	2,737	10,656

TABLE No. 15.

*Requests for Extension of Time or Removal of Articles in Cold Storage.*REQUESTS FOR EXTENSION OF TIME ON GOODS IN COLD STORAGE GRANTED DURING THE
YEAR, DEC. 1, 1914, TO DEC. 1, 1915.

(Reason for such extensions being that goods were in proper condition for further storage.)

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Eggs, broken out, .	870	Dec. 30, 1913	Indefinitely ¹	Keith, H. J., Company.
Eggs, broken out, .	10	Mar. 26, 1914	Indefinitely ¹	Keith, H. J., Company.
Eggs, broken out, .	3,780	May 2, 1914	July 1, 1915	Marston, R., Company.
Eggs, dried, . .	9,000	Aug. 1, 1914	Dec. 31, 1915	Campbell, E. C., Company.
Eggs, dried, . .	2,850	Aug. 1, 1914	Dec. 31, 1915	Campbell, E. C., Company.
Eggs, dried, . .	300	Nov. 4, 1914	Mar. 20, 1916	Campbell, E. C., Company.
Eggs, dried, . .	850	Nov. 4, 1914	Mar. 20, 1916	Campbell, E. C., Company.
Eggs, dried, . .	625	Nov. 4, 1914	Mar. 20, 1916	Campbell, E. C., Company.
Egg whites, . .	25	July 21, 1914	Oct. 1, 1915	Brown, M.
Butter, . . .	3,960	Jan. 6, 1914	Mar. 1, 1915	Batchelder & Snyder Company.
Butter, . . .	3,080	Jan. 31, 1914	Mar. 31, 1915	Batchelder & Snyder Company.
Butter, . . .	1,400	Apr. 8, 1914	June 8, 1915	Batchelder & Snyder Company.
Butter, . . .	1,800	Aug. 1, 1914	Sept. 30, 1915	Batchelder & Snyder Company.
Butter, . . .	1,140	Aug. 26, 1914	Nov. 30, 1915	Beebe, Elmer.
Butter, . . .	1,200	May 23, 1914	Aug. 31, 1915	Brown, DeLoria Company.
Butter, . . .	1,071	May 19, 1914	June 15, 1915	Covitz, M., & Son.
Butter, . . .	1,020	Aug. 6, 1914	Sept. 6, 1915	Covitz, M., & Son.
Butter, . . .	120	Aug. 7, 1914	Sept. 7, 1915	Covitz, M., & Son.
Butter, . . .	4,080	May 20, 1914	Aug. 20, 1915	Eastern Butter Company.
Butter, . . .	860	Aug. 28, 1914	Nov. 30, 1915	Eastern Butter Company.
Butter, . . .	2,760	Aug. 24, 1914	Nov. 30, 1915	Eastern Butter Company.
Butter, . . .	90	May 21, 1914	Nov. 20, 1915	Eastern Cold Storage Company.
Butter, . . .	120	Aug. 26, 1914	Sept. 26, 1915	Ellis, George H.
Butter, . . .	60	June 4, 1914	Oct. 1, 1915	Fowle, Hibbard Company.
Butter, . . .	300	June 4, 1914	Nov. 1, 1915	Fowle, Hibbard Company.
Butter, . . .	180	July 11, 1914	Nov. 1, 1915	Fowle, Hibbard Company.
Butter, . . .	770	Sept. 5, 1914	Jan. 1, 1916	Fowle, Hibbard Company.
Butter, . . .	580	Oct. 10, 1914	Jan. 1, 1916	Fowle, Hibbard Company.
Butter, . . .	3,060	Dec. 31, 1913	Mar. 31, 1915	Green & Co.
Butter, . . .	2,700	Sept. 8, 1914	Jan. 11, 1916	Green & Co.
Butter, . . .	1,980	July 3, 1914	Nov. 3, 1915	Haire, William J., Company.
Butter, . . .	900	Oct. 23, 1914	Jan. 24, 1916	Haire, William J., Company.

¹ For experimental purposes.

Requests for Extension of Time or Removal of Articles in Cold Storage — Continued.

REQUESTS FOR EXTENSION OF TIME ON GOODS IN COLD STORAGE GRANTED DURING THE
YEAR, DEC. 1, 1914, TO DEC. 1, 1915 — *Continued.*

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Butter, . . .	1,860	Oct. 24, 1914	Jan. 24, 1916	Haire, William J., Company.
Butter, . . .	1,320	Oct. 24, 1914	Jan. 24, 1916	Haire, William J., Company.
Butter, . . .	500	Sept. 9, 1914	Jan. 8, 1916	Hilton & Aldrich Company.
Butter, . . .	1,152	June 2, 1914	Oct. 15, 1915	Humphrey, J. L.
Butter, . . .	3,320	June 18, 1914	Oct. 15, 1915	Humphrey, J. L.
Butter, . . .	2,760	June 23, 1914	Oct. 15, 1915	Humphrey, J. L.
Butter, . . .	448	July 3, 1914	Oct. 15, 1915	Humphrey, J. L.
Butter, . . .	500	July 8, 1914	Sept. 7, 1915	Johnson, H. A., Company.
Butter, . . .	2,160	Mar. 3, 1914	Apr. 15, 1915	Kennard, Alex D.
Butter, . . .	11,280	Mar. 3, 1914	Apr. 15, 1915	Kennard, Alex D.
Butter, . . .	2,880	Aug. 25, 1914	Nov. 25, 1915	Massasoit Creamery Company.
Butter, . . .	2,142	Aug. 4, 1914	Nov. 1, 1915	Mills Tea and Butter Company.
Butter, . . .	4,950	July 15, 1914	Nov. 1, 1915	Mills Tea and Butter Company.
Butter, . . .	850	Aug. 28, 1914	Oct. 1, 1915	Osgood, C. H.
Butter, . . .	396	July 9, 1914	Sept. 9, 1915	Plymouth Creamery Company.
Butter, . . .	288	June 13, 1914	Oct. 1, 1915	Plymouth Creamery Company.
Butter, . . .	500	Aug. 9, 1914	Nov. 1, 1915	Shawmut Egg Company.
Butter, . . .	600	May 2, 1914	July 1, 1915	Thomas, J. M., & Co.
Butter, . . .	600	Jan. 23, 1914	Feb. 10, 1915	Union Supply Company.
Butter, . . .	330	Aug. 19, 1914	Sept. 14, 1915	Winer, M., & Co.
Broilers, . . .	332	Dec. 5, 1913	Mar. 2, 1915	Dorr, Arthur E., & Co.
Broilers, . . .	3,056	Mar. 12, 1914	June 12, 1915	Hosmer, F. H., & Co.
Broilers, . . .	2,324	May 19, 1914	Aug. 19, 1915	Swan, Newton & Co.
Chickens, . . .	463	Jan. 6, 1914	Mar. 31, 1915	Dorr, Arthur E., & Co.
Chickens, . . .	408	Jan. 9, 1914	Mar. 31, 1915	Dorr, Arthur E., & Co.
Chickens, . . .	464	Jan. 28, 1914	Feb. 28, 1915	Dorr, Arthur E., & Co.
Chickens, . . .	110	Dec. 15, 1913	Feb. 6, 1915	Hosmer, F. H., & Co.
Chickens, . . .	353	Dec. 8, 1913	Jan. 31, 1915	Kimball, J. F., & Co.
Chickens, . . .	1,242	Dec. 6, 1913	Jan. 31, 1915	Kimball, J. F., & Co.
Chickens, . . .	115	July 8, 1914	July 19, 1915	Murphy, R. A., Company.
Chickens, . . .	316	Aug. 25, 1914	Oct. 1, 1915	Osgood, C. H.
Chickens, . . .	950	Jan. 1, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	1,531	Jan. 2, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	123	Jan. 3, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	497	Jan. 7, 1914	June 1, 1915	Slayton & Boynton.

Requests for Extension of Time or Removal of Articles in Cold Storage — Continued.

REQUESTS FOR EXTENSION OF TIME ON GOODS IN COLD STORAGE GRANTED DURING THE
YEAR, DEC. 1, 1914, TO DEC. 1, 1915 — *Continued.*

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Chickens, . . .	796	Jan. 7, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	327	Jan. 10, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	185	Jan. 10, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	122	Jan. 10, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	1,272	Jan. 14, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	181	Jan. 17, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	1,239	Jan. 17, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	1,305	Jan. 23, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	398	Jan. 28, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	373	Jan. 28, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	316	Feb. 4, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	250	Feb. 6, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	210	Feb. 6, 1914	June 1, 1915	Slayton & Boynton.
Chickens, . . .	22	Apr. 15, 1914	Indefinitely ¹	State Department of Health.
Ducks, . . .	225	Dec. 26, 1913	Mar. 29, 1915	Dorr, Arthur E., & Co.
Ducks, . . .	402	Aug. 25, 1914	Nov. 30, 1915	Dorr, Arthur E., & Co.
Ducks, . . .	1,480	Aug. 27, 1914	Nov. 30, 1915	Dorr, Arthur E., & Co.
Ducks, . . .	452	Aug. 29, 1914	Nov. 30, 1915	Dorr, Arthur E., & Co.
Ducks, . . .	28	Apr. 21, 1914	Indefinitely ¹	State Department of Health.
Fowl, . . .	240	Dec. 2, 1913	Mar. 2, 1915	Dorr, Arthur E., & Co.
Fowl, . . .	52	Dec. 29, 1913	Jan. 31, 1915	Dorr, Arthur E., & Co.
Fowl, . . .	400	Dec. 30, 1913	Jan. 31, 1915	Dorr, Arthur E., & Co.
Fowl, . . .	102	Jan. 5, 1914	Feb. 15, 1915	Dorr, Arthur E., & Co.
Fowl, . . .	390	Jan. 28, 1914	Feb. 28, 1915	Dorr, Arthur E., & Co.
Fowl, . . .	1,791	June 16, 1914	Oct. 1, 1915	Osgood, C. H.
Fowl, . . .	74	Aug. 8, 1914	Sept. 10, 1915	Pratt, F. B., & Co.
Fowl, . . .	159	July 19, 1914	July 24, 1915	Swift, E. C., & Co.
Geese, . . .	286	Dec. 26, 1913	Mar. 29, 1915	Dorr, Arthur E., & Co.
Geese, . . .	408	Dec. 27, 1913	Mar. 29, 1915	Dorr, Arthur E., & Co.
Geese, . . .	1,525	Dec. 29, 1913	Feb. 28, 1915	Dorr, Arthur E., & Co.
Geese, . . .	159	Dec. 31, 1913	Feb. 28, 1915	Dorr, Arthur E., & Co.
Geese, . . .	161	Dec. 30, 1913	Jan. 31, 1915	Dorr, Arthur E., & Co.
Guinea chickens, .	120	Dec. 8, 1913	Mar. 2, 1915	Dorr, Arthur E., & Co.
Guinea chickens, .	468	Dec. 22, 1913	Mar. 29, 1915	Dorr, Arthur E., & Co.

¹ For experimental purposes.

Requests for Extension of Time or Removal of Articles in Cold Storage — Continued.

REQUESTS FOR EXTENSION OF TIME ON GOODS IN COLD STORAGE GRANTED DURING THE
YEAR, DEC. 1, 1914, TO DEC. 1, 1915 — *Continued.*

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to—	Name.
Roosters, . . .	289	Dec. 29, 1913	Feb. 28, 1915	Dorr, Arthur E., & Co.
Roosters, . . .	4,434	June 16, 1914	Oct. 1, 1915	Osgood, C. H.
Roosters, . . .	2,500	July 29, 1914	Oct. 1, 1915	Osgood, C. H.
Roosters, . . .	843	Aug. 8, 1914	Oct. 1, 1915	Osgood, C. H.
Roosters, . . .	1,123	Aug. 15, 1914	Oct. 1, 1915	Osgood, C. H.
Roosters, . . .	423	Aug. 18, 1914	Oct. 1, 1915	Osgood, C. H.
Roosters, . . .	2,747	Aug. 26, 1914	Oct. 1, 1915	Osgood, C. H.
Roosters, . . .	2,572	Sept. 30, 1914	Dec. 1, 1915	Osgood, C. H.
Roosters, . . .	1,731	Sept. 23, 1914	Dec. 1, 1915	Osgood, C. H.
Squab, . . .	162½	Dec. 13, 1913	Mar. 2, 1915	Dorr, Arthur E., & Co.
Squab, . . .	20	Oct. 27, 1914	Jan. 27, 1916	Dorr, Arthur E., & Co.
Turkeys, . . .	224	Dec. 29, 1913	Jan. 31, 1915	Dorr, Arthur E., & Co.
Turkeys, . . .	1,623	Aug. 26, 1914	Oct. 26, 1915	Dorr, Arthur E., & Co.
Turkeys, . . .	6,915	Dec. 8, 1913	Mar. 31, 1915	Swan Newton & Company.
Turkeys, . . .	11,036	Dec. 30, 1913	Mar. 31, 1915	Swan Newton & Company.
Miscellaneous poultry,	19	Aug. 3, 1914	Oct. 1, 1915	Atwood Brothers.
Beef, . . .	6,147	Nov. 4, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef, . . .	47,126	Nov. 20, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef, . . .	13,813	Dec. 2, 1914	Apr. 30, 1916	New England Dressed Meat and Wool Company.
Beef, . . .	41,102	Dec. 2, 1914	Apr. 30, 1916	New England Dressed Meat and Wool Company.
Beef, . . .	41,986	Dec. 4, 1914	Apr. 30, 1916	New England Dressed Meat and Wool Company.
Beef butts, . . .	1,340	Oct. 30, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef butts, . . .	1,202	Nov. 4, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef chucks, . . .	1,368	Oct. 30, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef clods, . . .	1,483	Nov. 4, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef loins, . . .	2,212	Aug. 12, 1914	Nov. 30, 1915	Dorr, Arthur E., & Co.
Beef loins, . . .	585	Sept. 23, 1914	Mar. 23, 1916	Dorr, Arthur E., & Co.
Beef loins, . . .	349	Oct. 2, 1914	Jan. 1, 1916	Dorr, Arthur E., & Co.
Beef loins, . . .	587	Oct. 15, 1914	Jan. 15, 1916	Dorr, Arthur E., & Co.
Beef loins, . . .	451	Oct. 21, 1914	Mar. 30, 1916	Dorr, Arthur E., & Co.
Beef loins, . . .	811	Oct. 27, 1914	Jan. 27, 1916	Dorr, Arthur E., & Co.
Beef loins, . . .	681	Nov. 3, 1914	Feb. 3, 1916	Dorr, Arthur E., & Co.
Beef loins, . . .	474	Nov. 30, 1914	Jan. 30, 1916	Dorr, Arthur E., & Co.
Beef loins, . . .	266	May 19, 1914	Aug. 1, 1915	Janvrin, J. D. L.
Beef loins, . . .	40	Apr. 28, 1914	July 31, 1915	Janvrin, J. D. L.

Requests for Extension of Time or Removal of Articles in Cold Storage — Continued.

REQUESTS FOR EXTENSION OF TIME ON GOODS IN COLD STORAGE GRANTED DURING THE
YEAR, DEC. 1, 1914, TO DEC. 1, 1915 — *Continued.*

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Beef ribs, . . .	166	Sept. 2, 1914	Oct. 1, 1915	Batchelder & Snyder Company.
Beef ribs, . . .	282	Dec. 10, 1913	Mar. 2, 1915	Dorr, Arthur E., & Co.
Beef rounds, . . .	4,452	Dec. 28, 1913	Mar. 1, 1915	Hollis, N. E., & Co.
Beef rounds, . . .	8,360	Dec. 28, 1913	Mar. 1, 1915	Hollis, N. E., & Co.
Beef rounds, . . .	2,773	Oct. 30, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef rounds, . . .	2,791	Nov. 4, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef rumps, . . .	791	Sept. 24, 1914	Jan. 24, 1916	Dorr, Arthur E., & Co.
Beef rumps, . . .	294	Oct. 27, 1914	Jan. 27, 1916	Dorr, Arthur E., & Co.
Beef tenderloins, . . .	422	Oct. 30, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef tenderloins, . . .	458	Nov. 4, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef veins, . . .	1,118	Oct. 30, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Beef veins, . . .	1,040	Nov. 4, 1914	Mar. 30, 1916	New England Dressed Meat and Wool Company.
Hog plucks, . . .	28,900	Dec. 14, 1914	Jan. 14, 1916	Poole, J. R., Company.
Kidneys (pork), . . .	9,100	Sept. 10, 1914	Dec. 30, 1915	Swift, E. C., & Co.
Lamb fries, . . .	800	Oct. 13, 1914	Jan. 30, 1916	Dorr, Arthur E., & Co.
Lamb fries, . . .	832	Oct. 14, 1914	Jan. 30, 1916	Dorr, Arthur E., & Co.
Lamb plucks, . . .	2,625	Oct. 30, 1914	Feb. 28, 1916	Dorr, Arthur E., & Co.
Livers, . . .	9,500	Sept. 23, 1914	Dec. 23, 1915	Zimmerman, M., Company.
Livers (beef), . . .	13,547	Nov. 10, 1914	Mar. 10, 1916	Woodbridge, S. F., Meat Company.
Livers (pork), . . .	19,596	May 22, 1914	July 22, 1915	Nye, George, Company.
Livers (sheep), . . .	461	Nov. 4, 1914	Mar. 4, 1916	Dorr, Arthur E., & Co.
Sweetbreads, . . .	105	Sept. 16, 1914	Dec. 16, 1915	Dorr, Arthur E., & Co.
Sweetbreads (calves),	43	July 28, 1914	Oct. 20, 1915	Squire, John P., Sons.
Sweetbreads (calves),	96¾	Aug. 5, 1914	Oct. 20, 1915	Squire, John P., Sons.
Sweetbreads (calves),	54½	July 21, 1914	Oct. 20, 1915	Squire, John P., Sons.
Sweetbreads (calves),	84	July 29, 1914	Oct. 20, 1915	Squire, John P., Sons.
Sweetbreads (calves),	140¾	July 23, 1914	Oct. 20, 1915	Squire, John P., Sons.
Sweetbreads (calves),	30	Aug. 5, 1914	Oct. 20, 1915	Squire, John P., Sons.
Venison, . . .	160	Dec. 11, 1913	Mar. 2, 1915	Dorr, Arthur E., & Co.
Venison, . . .	72	July 15, 1914	Dec. 30, 1915	Dorr, Arthur E., & Co.
Venison, . . .	37	July 25, 1914	Dec. 30, 1915	Dorr, Arthur E., & Co.
Butterfish, . . .	10,472	July 22, 1914	Nov. 30, 1915	Atwood & Co.
Butterfish, . . .	300	Aug. 16, 1914	Nov. 30, 1915	Rich, H. A., Company.
Butterfish, . . .	1,200	Dec. —, 1914	Jan. 1, 1916	Rich, H. A., Company.
Cusk, . . .	370	Nov. 5, 1914	Nov. 30, 1915	Hoare, William J., Company.

*Requests for Extension of Time or Removal of Articles in Cold Storage — Continued.*REQUESTS FOR EXTENSION OF TIME ON GOODS IN COLD STORAGE GRANTED DURING THE YEAR, DEC. 1, 1914, TO DEC. 1, 1915 — *Continued.*

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Haddock, . . .	1,350	July 22, 1914	Oct. 31, 1915	Bunting & Emery Company.
Haddock, . . .	500	- -	Dec. 1, 1915	Ocean Fish Company.
Halibut, . . .	570	Aug. 29, 1914	Dec. 1, 1915	Atlas Fish Company.
Halibut, . . .	530	Aug. 25, 1914	Dec. 1, 1915	Atlas Fish Company.
Halibut, . . .	350	Oct. 31, 1914	Dec. 30, 1915	T Wharf Fish Company.
Halibut, . . .	337	Nov. 7, 1914	Jan. 15, 1916	T Wharf Fish Company.
Halibut, . . .	4,808	Nov. 16, 1914	Jan. 16, 1916	Whitman, Ward & Lee.
Halibut cheeks, . .	135	July 29, 1914	Nov. 20, 1915	New England Fish Company.
Mackerel, . . .	1,776	Dec. 18, 1914	Jan. 31, 1916	Arnold & Winsor Company.
Mackerel, . . .	1,045	Nov. 12, 1914	Feb. 1, 1916	Arnold & Winsor Company.
Mackerel, . . .	120	Aug. 9, 1914	Dec. 1, 1915	Atlas Fish Company.
Mackerel, . . .	900	Oct. 30, 1914	Dec. 4, 1915	Atlantic and Pacific Fish Com- pany.
Mackerel, . . .	3,000	Oct. 30, 1914	Dec. 4, 1915	Atlantic and Pacific Fish Com- pany.
Mackerel, . . .	150	Aug. 14, 1914	Nov. 30, 1915	Commonwealth Ice and Cold Storage Company.
Mackerel, . . .	350	Aug. 14, 1914	Nov. 30, 1915	Commonwealth Ice and Cold Storage Company.
Mackerel, . . .	135	Nov. 11, 1914	Feb. 1, 1916	Commonwealth Ice and Cold Storage Company.
Mackerel, . . .	540	Nov. 7, 1914	Feb. 1, 1916	Commonwealth Ice and Cold Storage Company.
Mackerel, . . .	200	Nov. 14, 1914	Dec. 15, 1915	Commonwealth Ice and Cold Storage Company.
Mackerel, . . .	4,200	July 10, 1914	Dec. 1, 1915	Fitch, Warren, Company.
Mackerel, . . .	1,000	July 10, 1914	Dec. 1, 1915	Fitch, Warren, Company.
Mackerel, . . .	1,200	Nov. 5, 1914	Jan. 1, 1916	Goodspeed, L. B., & Co.
Mackerel, . . .	150	Oct. 26, 1914	Jan. 1, 1916	Goodspeed, L. B., & Co.
Mackerel, . . .	610	Nov. 6, 1914	Jan. 1, 1916	Goodspeed, L. B., & Co.
Mackerel, . . .	2,100	Nov. 30, 1914	Jan. 30, 1916	Harding, F. E., Company.
Mackerel, . . .	1,300	Jan. 10, 1914	Feb. 28, 1915	Malone, E. A.
Mackerel, . . .	2,500	June 10, 1914	Oct. 30, 1915	Rich, E. A., Company.
Mackerel, . . .	135	Aug. 14, 1914	Nov. 30, 1915	Rich, E. A., Company.
Mackerel, . . .	2,100	Nov. 5, 1914	Feb. 1, 1916	Rich, E. A., Company.
Mackerel, . . .	2,595	Nov. 17, 1914	Feb. 1, 1916	Rich, E. A., Company.
Mackerel, . . .	877	Nov. 13, 1914	Feb. 1, 1916	Rich, E. A., Company.
Pollock, . . .	1,632	Dec. 4, 1914	Feb. 4, 1916	Bunting & Emery Company.
Pollock, . . .	465	Dec. 3, 1914	Feb. 3, 1916	Bunting & Emery Company.
Pollock, . . .	16,500	Oct. 10, 1914	Nov. 15, 1915	Burns, John, Company.
Pollock, . . .	855	July 2, 1914	Oct. 31, 1915	United Fish Company.
Salmon, . . .	140	Nov. 28, 1914	Jan. 28, 1916	Atlas Fish Company.

Requests for Extension of Time or Removal of Articles in Cold Storage—Continued.

REQUESTS FOR EXTENSION OF TIME ON GOODS IN COLD STORAGE GRANTED DURING THE YEAR, DEC. 1, 1914, TO DEC. 1, 1915 — *Concluded.*

ARTICLE.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Salmon, . . .	375	Nov. 28, 1914	Jan. 28, 1916	Atlas Fish Company.
Salmon, . . .	5,275	June 22, 1914	Sept. 1, 1915	Ellis, E. S., & Co.
Salmon, . . .	7,645	June 18, 1914	Sept. 1, 1915	Ellis, E. S., & Co.
Salmon, . . .	6,307	July 3, 1914	Sept. 1, 1915	Freeman & Cobb.
Salmon, . . .	6,000	July 16, 1914	Aug. 28, 1915	Star Fish Company.
Salmon, . . .	500	July 16, 1914	Aug. 28, 1915	Star Fish Company.
Whiting, . . .	1,094	Aug. 20, 1914	Nov. 30, 1915	Busalacchi Brothers.
Whiting, . . .	1,096	Aug. 20, 1914	Nov. 30, 1915	Busalacchi Brothers.
Whiting, . . .	1,475	Aug. 20, 1914	Oct. 15, 1915	Mantia, G.
Whiting, . . .	375	Aug. 20, 1914	Oct. 15, 1915	Mantia, G.
Whiting, . . .	500	Aug. 20, 1914	Oct. 15, 1915	Mantia, G.
Whiting, . . .	375	Aug. 20, 1914	Oct. 15, 1915	Mantia, G.

REQUESTS FOR EXTENSION OF TIME ON GOODS IN COLD STORAGE NOT GRANTED DURING THE YEAR, DEC. 1, 1914, TO DEC. 1, 1915.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Permission to remove.	Name.
Butter, . . .	2,940	Sept. 10, 1915	Sept. 14, 1915 ¹	Beebe, Elmer.
Butter, . . .	300	Aug. 26, 1914	Sept. 14, 1915 ¹	Beebe, Elmer.
Butter, . . .	720	Aug. 26, 1914	Sept. 14, 1915 ¹	Beebe, Elmer.
Livers (sheep), . .	505	Aug. 15, 1914	Nov. 29, 1915 ²	Goodspeed, L. B., & Co.
Halibut, . . .	400	Apr. 8, 1914	Nov. 20, 1915 ³	Goodspeed, L. B., & Co.
Mackerel, . . .	380	Nov. 12, 1914	Nov. 12, 1915 ¹	Arnold & Winsor Company.
Scrod haddock, . .	7,170	Oct. 8, 1914	Nov. 13, 1915 ¹	Goodspeed, L. B., & Co.

¹ Not in proper condition for further storage.

² Already in storage fifteen months.

³ Already in storage nineteen months.

Requests for Extension of Time or Removal of Articles in Cold Storage—Continued.

REQUESTS FOR PERMISSION TO REMOVE ARTICLES WHICH HAD BEEN IN COLD STORAGE LONGER THAN TWELVE MONTHS GRANTED DURING THE YEAR, DEC. 1, 1914, TO DEC. 1, 1915.

ARTICLE.	Weight (Pounds).	Placed in Storage.	Permission to remove.	Name.
Butter, . . .	50	Aug. 22, 1913	Feb. 15, 1915	Boston Terminal Refrigerating Company.
Butter, . . .	60	Sept. 5, 1913	Feb. 15, 1915	Boston Terminal Refrigerating Company.
Butter, . . .	60	Sept. 30, 1913	Feb. 17, 1915	Boston Terminal Refrigerating Company.
Butter, . . .	60	July 18, 1914	Nov. 29, 1915	Eastern Cold Storage Company.
Butter, . . .	60	Oct. 3, 1914	Nov. 29, 1915	Eastern Cold Storage Company.
Butter, . . .	240	July 9, 1914	Nov. 29, 1915	Eastern Cold Storage Company.
Butter, . . .	30	May 29, 1913	Nov. 29, 1915	Eastern Cold Storage Company.
Butter, . . .	60	June 7, 1913	Nov. 29, 1915	Eastern Cold Storage Company.
Butter, . . .	60	June 12, 1913	Nov. 29, 1915	Eastern Cold Storage Company.
Butter, . . .	60	Sept. 18, 1913	Nov. 29, 1915	Eastern Cold Storage Company.
Butter, . . .	60	June 20, 1914	Nov. 29, 1915	Eastern Cold Storage Company.
Butter, . . .	60	June 24, 1914	Nov. 29, 1915	Eastern Cold Storage Company.
Butter, . . .	60	July 9, 1914	Nov. 29, 1915	Eastern Cold Storage Company.
Butter, . . .	30	June 6, 1914	June 18, 1915	Stone, Charles H., & Co.
Butter, . . .	20	July 6, 1914	Aug. 11, 1915	Heslor, J., & Co.
Broilers, . . .	58	Dec. 24, 1913	Jan. 18, 1915	Boston Terminal Refrigerating Company.
Capons, . . .	243	Dec. 9, 1913	Feb. 6, 1915	Boston Terminal Refrigerating Company.
Capons, . . .	237	Jan. 23, 1914	Feb. 12, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	256	Nov. 19, 1913	Feb. 1, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	70	Nov. 25, 1913	Feb. 1, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	36	Dec. 13, 1913	Feb. 6, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	40	Dec. 16, 1913	Feb. 6, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	62	Nov. 1, 1913	Feb. 10, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	537	Nov. 9, 1913	Dec. 19, 1914	Boston Terminal Refrigerating Company.
Chickens, . . .	26	Nov. 21, 1913	Jan. 18, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	120	Nov. 28, 1913	Jan. 4, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	35	Nov. 27, 1913	Dec. 19, 1914	Boston Terminal Refrigerating Company.
Chickens, . . .	80	Nov. 28, 1913	Jan. 4, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	80	Dec. 6, 1913	Jan. 4, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	62	Dec. 27, 1913	Jan. 20, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	45	Dec. 29, 1913	Jan. 20, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	65	Nov. 1, 1913	Apr. 12, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	37	- -	Apr. 17, 1915	Boston Terminal Refrigerating Company.
Chickens, . . .	30	June 29, 1914	Sept. 25, 1915	Eastern Cold Storage Company.

Requests for Extension of Time or Removal of Articles in Cold Storage — Concluded.

REQUESTS FOR PERMISSION TO REMOVE ARTICLES WHICH HAVE BEEN IN COLD STORAGE LONGER THAN TWELVE MONTHS GRANTED DURING THE YEAR, DEC. 1, 1914, TO DEC. 1, 1915 — *Concluded.*

ARTICLE.	Weight (Pounds).	Placed in Storage.	Permission to remove.	Name.
Chickens, . . .	1,375	Jan. 14, 1914	Jan. 25, 1915	Kimball, J. F., & Co.
Chickens, . . .	1,696	Jan. 14, 1914	Jan. 25, 1915	Kimball, J. F., & Co.
Chickens, . . .	13	Jan. 14, 1914	Jan. 25, 1915	Kimball, J. F., & Co.
Chickens, . . .	402	Jan. 14, 1914	Jan. 25, 1915	Kimball, J. F., & Co.
Ducks, . . .	70	June 29, 1914	Sept. 25, 1915	Eastern Cold Storage Company.
Fowl, . . .	39	Dec. 29, 1913	Aug. 31, 1915	Consolidated Meat and Grocery Company.
Fowl, . . .	427	Jan. 1, 1914	Jan. 22, 1915	Dorr, Arthur E., & Co.
Fowl, . . .	252	Jan. 7, 1914	Jan. 22, 1915	Dorr, Arthur E., & Co.
Geese, . . .	224	Dec. 5, 1913	Feb. 1, 1915	Boston Terminal Refrigerating Company.
Geese, . . .	187	Jan. 1, 1914	Feb. 1, 1915	Boston Terminal Refrigerating Company.
Geese, . . .	241	Dec. 16, 1913	Feb. 6, 1915	Boston Terminal Refrigerating Company.
Geese, . . .	82	Jan. 23, 1914	Feb. 10, 1915	Boston Terminal Refrigerating Company.
Geese, . . .	812	Jan. 2, 1914	Jan. 22, 1915	Dorr, Arthur E., & Co.
Geese, . . .	441	Jan. 6, 1914	Jan. 22, 1915	Dorr, Arthur E., & Co.
Guinea chickens, . .	120	Oct. 16, 1913	Jan. 18, 1915	Boston Terminal Refrigerating Company.
Turkeys, . . .	262	Dec. 26, 1913	Feb. 10, 1915	Boston Terminal Refrigerating Company.
Turkeys, . . .	190	Jan. 31, 1914	Feb. 17, 1915	Boston Terminal Refrigerating Company.
Turkeys, . . .	1,110	Nov. 27, 1914	Oct. 5, 1915	Borst, Pierce Company.
Turkeys, . . .	9,624	Dec. 24, 1913	Aug. 7, 1915	Hanly, E. A., Company.
Beef, . . .	741	Dec. 16, 1913	Feb. 6, 1915	Boston Terminal Refrigerating Company.
Beef, . . .	355	Dec. 20, 1913	Feb. 10, 1915	Boston Terminal Refrigerating Company.
Beef butts, . . .	115	Nov. 3, 1914	Nov. 29, 1915	Hanly, E. A., Company.
Beef ribs, . . .	788	Aug. 20, 1914	Sept. 6, 1915	Sulzberger & Sons Company.
Beef ribs, . . .	661	Aug. 26, 1914	Sept. 6, 1915	Sulzberger & Sons Company.
Livers (calves'), . .	169	Aug. 30, 1913	Feb. 10, 1915	Boston Terminal Refrigerating Company.
Livers (calves'), . .	45	June 10, 1914	Sept. 1, 1915	Cummings & Cummings.
Livers (calves'), . .	49	Mar. 12, 1914	Sept. 1, 1915	Cummings & Cummings.
Raccoons, . . .	16	Oct. 12, 1914	Nov. 4, 1915	Stevens, Genery, & Son.
Sweetbreads, . . .	39	Aug. 13, 1914	Sept. 4, 1915	Squire, John P., & Sons.
Bluefish, . . .	900	Oct. 9, 1914	Oct. 28, 1915	Rich, H. A., Company.
Butterfish, . . .	3,010	July 29, 1914	Aug. 12, 1915	Prior & Townsend.
Salmon, . . .	138	Sept. 4, 1914	Oct. 4, 1915	Goodspeed, L. B., & Co.
Salmon, . . .	1,343	Mar. 27, 1914	July 3, 1915	Rich, E. A., Company.
Salmon, . . .	1,079	Mar. 27, 1914	July 3, 1915	Rich, E. A., Company.

TABLE NO. 16.

Articles placed in Cold Storage and Quantities of Butter and Eggs held during the Year, Oct. 1, 1914, to Oct. 1, 1915.

ARTICLES PLACED IN COLD STORAGE.	October, November, December, 1914.	January, February, March, 1915.	April, May, June, 1915.	July, August, September, 1915.	Totals.
Eggs, case (dozens), ¹ . . .	544,920	1,513,980	20,904,680	3,001,735	25,965,315
Eggs, broken (pounds), . . .	175,703	322,420	789,690	581,764	1,869,577
Butter (pounds), . . .	2,795,183	1,634,128	14,228,565½	19,805,829	38,463,705½
Poultry (pounds), . . .	8,048,596¾	4,826,702½	2,184,163	1,719,195¼	16,778,659½
Game (pounds), . . .	31,529	5,875	2,225	2,768	42,397
Meat, fresh (pounds), . . .	8,416,137½	20,802,741½	8,303,538½	6,189,935¾	43,712,353¼
Meat products, fresh (pounds), .	831,387	278,967	2,200,980	195,196	3,506,530
Fish, fresh food (pounds), . .	4,314,058	5,754,288	7,540,856	9,424,402	27,033,604
Totals, . . .	25,157,516¼	35,139,102	56,154,698	40,920,825	157,372,141¼
Eggs, case (per cent.), " . . .	2.2	5.8	80.6	11.4	100.0
Eggs, broken (per cent.), . . .	9.5	17.2	42.1	31.2	100.0
Butter (per cent.), . . .	7.3	4.2	37.0	51.5	100.0
Poultry (per cent.), . . .	48.0	28.8	12.9	10.3	100.0
Game (per cent.), . . .	74.5	7.4	5.3	13.8	100.0
Meat, fresh (per cent.), . . .	19.3	47.6	19.0	14.1	100.0
Meat products, fresh (per cent.), .	23.7	7.9	62.8	5.6	100.0
Fish, fresh food (per cent.), . .	15.9	21.3	28.0	34.8	100.0

BUTTER AND EGGS HELD IN COLD STORAGE.	Jan. 1, 1915.	Apr. 1, 1915.	July 1, 1915.	Oct. 1, 1915.
Eggs, case (dozens), . . .	5,402,863½	1,307,289	22,166,910	19,556,190
Eggs, broken (pounds), . . .	9,102	25,381	72,869	112,163
Butter (pounds), . . .	10,210,622	1,315,732	12,150,428½	27,544,187
Totals, . . .	15,622,587½	2,648,402	34,390,207½	47,212,540

¹ The net weight of 1 dozen eggs, exclusive of the shells, is approximately 1 pound.

TABLE 17.

Cold-storage Warehouses licensed during the Year Dec. 1, 1914, to Dec. 1, 1915.

NAME.	Location of Warehouse.	Date of License.
Allen, Slade & Co., ...	18-30 Third Street, Fall River, . . .	Sept. 1, 1915
Austin, Nichols & Co., Inc., ...	343 Bridge Street, Springfield, ¹ . . .	May 1, 1915
Bancroft, George, & Co., ...	264 Lowell Street, Lawrence, . . .	July 3, 1915
Batchelder & Snyder Company, ...	47-63 Blackstone Street, Boston, . . .	Jan. 4, 1915
Booth Fisheries Company, ...	30-33 Boston Fish Pier, Boston, . . .	Sept. 1, 1915
Boston Storage Company, ...	2-40 New Street, East Boston, . . .	Sept. 1, 1915
Boston Terminal Refrigerating Company, .	239 Sumner Street, East Boston, . . .	Sept. 1, 1915
Brockton Public Market, ...	155 Main Street, Brockton, . . .	May 24, 1915
Burns, John, Company, ...	8 Boston Fish Pier, Boston, . . .	Aug. 1, 1915
Butler-Paige Company, ...	140-142 Lyman Street, Springfield, . .	Apr. 27, 1915
Butler-Paige Company, ...	81 Clapp Avenue, Pittsfield, ² . . .	Sept. 1, 1915
Cape Ann Cold Storage Company, ...	Fort Square, Gloucester, . . .	July 23, 1915
Cape Cod Cold Storage Company, ...	123 Commercial Street, Provincetown, .	May 28, 1915
Cape Cod Fish Freezing and Packing Company.	Barnstable, ...	June 15, 1915
Clapp & Clapp, ...	147 Main Street, Northampton, . . .	Oct. 15, 1915
Cobb, Bates & Yerxa Company, ...	2 City Square, Taunton, . . .	Nov. 1, 1915
Colonial Cold Storage Company, ...	Commercial Street, Provincetown, . . .	Oct. 1, 1915
Commonwealth Ice and Cold Storage Company.	212-234 Northern Avenue, Boston, . .	Oct. 29, 1915
Conant, Chapin Company, ...	8 Monument Square, Leominster, . . .	Jan. 27, 1915
Consolidated Weir Company, ...	503 Commercial Street, Provincetown, .	Sept. 1, 1915
Cudahy Packing Company, ...	600 Essex Street, Lawrence, . . .	Aug. 13, 1915
Cudahy Packing Company, ...	172 Foster Street, Worcester, . . .	Aug. 4, 1915
Dexter, S. K., Company, ...	360 Middlesex Street, Lowell, . . .	June 5, 1915
Dillon & Douglass, ...	343 Bridge Street, Springfield, ¹ . . .	Sept. 1, 1915
Dorr, Arthur E., & Co., Inc., ...	5 Union Street, Boston, . . .	Dec. 12, 1914
Eastern Cold Storage Company, ...	28-44 North Street, Boston, . . .	Sept. 1, 1915
Eastern States Refrigerating Company, . .	Bridge, Dwight and Hillman Streets, Springfield.	Sept. 1, 1915
Fisherman Cold Storage Company, ...	Commercial Street, Provincetown, . . .	Sept. 1, 1915
Fitchburg Public Market, ...	1068 Main Street, Fitchburg, . . .	Apr. 3, 1915
Gloucester Cold Storage and Warehouse Company.	89 Rogers Street, Gloucester, . . .	Aug. 13, 1915
Hood, H. P., & Sons, ...	193 Alley Street, West Lynn, . . .	June 12, 1915
Humphrey, J. L., Jr., ...	95-97 Front Street, New Bedford, . . .	Sept. 1, 1915
Hunt, A. C., & Co., ...	16-32 Sanford Street, Springfield, . . .	Sept. 1, 1915
King's Public Market Company, ...	152-154 State Street, Springfield, . . .	Dec. 1, 1914
Lawrence Market Company, ...	534-536 Essex Street, Lawrence, . . .	July 19, 1915
Lawrence Produce Company, ...	616 Essex Street, Lawrence, . . .	Aug. 25, 1915

¹ Room in Eastern States Refrigerating Company, Springfield.² Room in New England Cold Storage and Warehouse Company, Pittsfield.

*Cold-storage Warehouses licensed during the Year, Dec. 1, 1914, to Dec. 1, 1915 —
Concluded.*

NAME.	Location of Warehouse.	Date of License.
Lowe Brothers Company, ...	10 Cushing Street, Fitchburg, . . .	May 15, 1915
Martha's Vineyard Cold Storage and Ice Company.	Beach Road, Vineyard Haven, . . .	Dec. 16, 1914
Mead, A. & O. W., & Co., ...	35-36 North Market Street, and through to 35 Clinton Street, Boston.	Sept. 1, 1915
Moulton, Edwin H., Company, ...	132 Essex Street, Haverhill, ...	Sept. 1, 1915
New England Cold Storage and Warehouse Company.	81 Clapp Avenue, Pittsfield, ...	Sept. 1, 1915
New England Dressed Meat and Wool Company.	Somerville Avenue, Somerville, . . .	Sept. 1, 1915
North Packing and Provision Company, . . .	61 Medford Street, Somerville, . . .	Sept. 1, 1915
North Truro Cold Storage Company, . . .	North Truro, ...	June 25, 1915
Nye, George, Company, ...	130 Lyman Street, Springfield, . . .	June 5, 1915
Nye, George, Company, ...	81 Clapp Avenue, Pittsfield, ¹ . . .	Sept. 1, 1915
Providence Public Market Company, . . .	242 Front Street, Worcester, ...	Aug. 19, 1915
Providence Public Market Company, . . .	627-633 Main Street, Worcester, . . .	Aug. 13, 1915
Provincetown Cold Storage Company, . . .	363 Commercial Street, Provincetown, .	May 1, 1915
Puritan Fish Freezing Company, ...	Good Templar Street, Provincetown, .	Oct. 1, 1915
Putnam, George E., & Son, ...	205-207 Market Street, Lowell, . . .	May 1, 1915
Quincy Market Cold Storage and Warehouse Company.	133-147 Commercial Street, Boston, 33-41 Richmond Street, Boston. 61-79 Clinton Street, Boston. 23-59 Eastern Avenue, Boston. 271-291 Commercial Street, Boston. 41-51 Mercantile Street, Boston. 409 Commercial Street, Boston. 20 Sanford Street, Springfield, ² . . .	Sept. 1, 1915
Ripley, E. V. N., ...	20 Sanford Street, Springfield, ² . . .	Dec. 7, 1914
Sandwich Freezer Company, Inc., ...	Rear Factory Street, Sandwich, . . .	June 5, 1915
Sheldon, W. O., ...	132 State Street, Springfield, . . .	Nov. 27, 1915
Shiel, Bernard F., ...	16-24 Sanford Street, Springfield, ² . .	May 11, 1915
Springfield Provision Company, ...	Plainfield Street, Brightwood, Chicopee,	Sept. 1, 1915
Squire, John P., & Co., ...	165 Gore Street, Cambridge, ...	Sept. 1, 1915
Squire, John P., & Co., ...	16 Main Street, Holyoke, ...	Sept. 1, 1915
Stevens, Genery, & Son, ...	58 Bridge Street, Worcester, ...	Sept. 1, 1915
Swift & Co. (E. C. Swift & Co.), ...	98 South Market Street, Boston, . . .	July 27, 1915
Swift & Co. (Anthony, Swift & Co.), . . .	66 Plymouth Avenue, Fall River, . .	Sept. 1, 1915
Swift & Co. (Swift, Coates & Co.), . . .	Clay Hill, Greenfield, ...	Sept. 1, 1915
Swift & Co., ...	22 Main Street, Holyoke, ...	Sept. 1, 1915
Swift & Co. (Swift & Bailey), ...	572 Dutton Street, Lowell, ...	Sept. 1, 1915
Swift & Co., ...	136-140 Pleasant Street, Lynn, . . .	Sept. 1, 1915
Swift & Co., ...	159 Ashland Street, North Adams, . .	Apr. 15, 1915
Swift & Co., ...	270 Bridge Street, Salem, ...	Sept. 1, 1915
Swift & Co. (G. H. Hammond), ...	274 Franklin Street, Worcester, . . .	Aug. 1, 1915
Worcester Cold Storage and Warehouse Company.	266 Franklin Street, Worcester, . . .	Sept. 1, 1915

¹ Room in New England Cold Storage and Warehouse Company, Pittsfield.

² Room in A. C. Hunt & Co.

TABLE No. 18.
Report on Inspection of Slaughtering, Oct. 1, 1914, to Oct. 1, 1915.

CITY OR TOWN.	INSPECTED.				CONDEMNED.			
	CATTLE.		HOGS.		CATTLE.		HOGS.	
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Abington, ...	87	122	377	-	1 tuberculosis, 1 parturient apoplexy.	3 immature, 1 emaciation,	2 tuberculosis, 1 cirrhosis of liver.	-
Acton, ...	179	952	263	30	2 tuberculosis, 1 difficult parturition.	26 immature, 1 stillborn.	2 hog cholera, 1 actinomycosis.	-
Acushnet, ...	29	258	321	-	-	-	-	-
Adams, ...	212	574	241	-	1 tuberculosis, ...	4 immature, ...	-	-
Agawam, ...	585	501	94	25	3 tuberculosis, 1 polyarthritis, 1 septicaemia, 1 parturient apoplexy.	13 immature, ...	-	-
Alford, ...	12	2	26	-	-	-	-	-
Amesbury, ...	7	83	114	3	1 tuberculosis, ...	-	-	-
Amherst, ...	86	353	169	2	3 tuberculosis, 1 toxamia,	-	1 hog cholera, ...	-
Andover, ...	10	23	254	-	-	-	-	-
Arlington, ...	-	-	-	-	-	-	-	-
Ashburnham, ...	9	67	53	7	1 tuberculosis, ...	-	-	-
Ashby, ...	220	789	162	7	13 tuberculosis, 1 paralysis,	3 emaciation, 1 enteritis, .	1 tuberculosis, 1 fever,	-
Ashfield, ...	100	50	281	21	1 tuberculosis, ...	-	1 tuberculosis, ...	-
Ashland, ...	4	27	104	11	2 tuberculosis, ...	-	-	-
Athol, ...	74	90	239	20	7 tuberculosis, ...	-	-	-
ATTLEBORO, ...	287	264	582	-	6 tuberculosis, ...	-	3 tuberculosis, 4 hog cholera, 1 abdominal abscesses.	-
Auburn, ...	139	205	178	2	5 tuberculosis, ...	-	-	-

Report on Inspection of Slaughtering, Oct. 1, 1914, to Oct. 1, 1915 — Continued.

CITY OR TOWN.	INSPECTED.				CONDEMNED.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Avon, ...	4	8	100	-	-	-	-	-
Ayer, ...	5	3	38	-	-	-	-	-
Barnstable, ...	28	138	241	-	-	-	-	-
Barre, ...	9	53	106	38	-	-	-	-
Becket, ...	16	14	42	26	-	-	-	-
Bedford, ...	1	-	694	-	-	-	-	-
Belchertown, ...	71	561	304	8	1 tuberculosis,	-	3 tuberculosis, 2 pulmonary congestion, 12 angina.	-
Bellingham, ...	26	10	75	-	-	-	1 tuberculosis,	-
Belmont, ...	-	2	44	-	-	-	-	-
Berkley, ...	5	8	77	1	-	-	-	-
Berlin, ...	42	66	89	-	4 tuberculosis,	-	-	-
Bernardston, ...	33	65	132	30	-	-	-	-
BEVERLY, ...	-	-	13	-	-	-	-	-
Billerica, ...	83	224	191	-	-	2 immature,	1 hog cholera,	-
Blackstone, ...	34	24	31	-	-	-	-	-
Blandford, ...	18	72	121	42	-	-	1 mammitis,	-
Bolton, ...	6	8	10	1	-	-	-	-
Bourne, ...	4	14	118	1	-	-	-	-
Boxborough, ...	5	68	16	-	-	-	-	-
Boxford, ...	161	288	166	16	-	2 immature, 2 natural death,	-	-

Boylston, .	52	150	221	12	1 tuberculosis, . . .	-	-	10 hog cholera, . .	-	-
Brantree, .	36	1,010	192	43	1 tuberculosis, 1 emacia- tion, 1 pneumonia.	-	-	-	-	-
Brewster, .	6	54	85	1	-	-	-	-	-	-
Bridgewater, .	7	13	344	1	-	-	-	1 hog cholera, . .	-	-
Brimfield, .	6	44	87	-	-	-	-	-	-	-
BROCKTON, .	145	138	271	17	7 tuberculosis, . . .	-	-	1 tuberculosis, 1 pneumo- nia.	-	-
Brookfield, .	15	51	146	14	-	-	-	1 tuberculosis, . .	-	-
Brookline, .	-	-	-	-	-	-	-	-	-	-
Buckland, .	13	-	50	7	-	-	-	-	-	-
Burlington, .	1	-	191	-	-	-	-	3 improperly prepared, .	-	-
CAMBRIDGE, .	-	2,231	-	-	-	-	65 immature, 12 weak con- dition, 7 emaciation, 3 dysentery.	-	-	-
Canton, .	-	-	52	-	-	-	-	1 gastritis, . . .	-	-
Carlisle, .	21	72	41	-	1 tuberculosis, . . .	-	-	-	-	-
Carver, .	42	189	14	1	-	-	7 immature, . . .	-	-	-
Charlemon't, .	27	26	143	25	-	-	-	-	-	-
Charlton, .	298	611	117	4	2 tuberculosis, . . .	-	1 immature, . . .	-	-	-
Chatham, .	4	8	102	-	-	-	-	-	-	-
Chelmsford, .	259	580	729	22	8 tuberculosis, 1 difficult parturition, 1 tumor.	-	7 immature, 1 bruised, 1 improperly bled.	1 tuberculosis, . .	-	-
CHEMSEA, .	-	-	-	-	-	-	-	-	-	-
Cheshire, .	60	167	304	2	2 tuberculosis, . . .	-	-	1 hog cholera, . .	-	-
Chester, .	17	97	78	34	-	-	-	-	-	-
Chesterfield, .	34	91	108	17	1 tuberculosis, . . .	-	-	-	-	-
Chicopee, .	36	14	338	-	-	-	-	-	-	-
Chilmark, .	10	9	10	126	-	-	-	-	-	-

Report on Inspection of Slaughtering, Oct. 1, 1914, to Oct. 1, 1915 — Continued.

City or Town.	INSPECTED.				CONDEMNED.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Clarksburg, ...	153	172	161	72	2 inspector not present, 1 septicaemia.	-	1 septicaemia, . . .	-
Clinton, ...	56	603	114	1	2 tuberculosiis, . . .	25 immature, . . .	-	-
Cohasset, ...	4	15	133	-	-	1 immature, . . .	-	-
Colrain, ...	110	12	275	10	5 tuberculosiis, . . .	-	-	-
Concord, ...	140	14	49	-	9 tuberculosiis, . . .	-	-	-
Conway, ...	39	78	83	39	-	-	-	-
Cunnington, ...	19	97	151	40	-	1 tuberculosiis, . . .	-	-
Dalton, ...	37	36	113	19	-	-	-	-
Dana, ...	7	6	55	2	1 tuberculosiis, . . .	-	-	-
Danvers, ...	-	336	-	-	-	-	-	-
Dartmouth, ...	539	1,488	579	183	21 tuberculosiis, 1 bruised, 1 parturient apoplexy.	63 immature, 1 bruised, . . .	2 tuberculosiis, . . .	-
Dedham, ...	31	1,775	269	-	1 tuberculosiis, . . .	-	2 hog cholera, . . .	-
Deerfield, ...	53	173	423	14	2 tuberculosiis, 1 injured, . . .	1 immature, . . .	-	-
Dennis, ...	4	26	96	11	-	-	1 sexual odor, . . .	-
Dighton, ...	275	330	175	13	3 tuberculosiis, . . .	4 immature, . . .	-	-
Douglas, ...	16	73	44	1	-	-	4 measles, . . .	-
Dover, ...	-	-	68	-	-	-	-	-
Dracut, ...	1,028	746	1,057	14	9 tuberculosiis, 1 prolapsus uleri.	22 immature, 1 diarrhoea, . . .	24 hog cholera, 1 tuberculosiis, 8 measles.	-
Dudley, ...	252	355	229	-	-	-	-	-
Dunstable, ...	26	11	23	-	1 tuberculosiis, . . .	-	-	-
Duxbury, ...	3	48	133	4	-	-	-	-

East Bridgewater, . . .	6	283	105	1	-	-	-	-	1 tuberculosi-	-	-
East Longmeadow, . .	58	17	52	-	-	2 tuberculosi-	-	-	-	-	-
Eastham, . . .	7	50	51	-	-	-	-	-	-	-	-
Easthampton, . . .	34	406	207	-	-	-	-	-	-	-	-
Easton, . . .	66	358	83	-	-	1 tuberculosi-	-	-	1 hog cholera,	-	-
Edgartown, . . .	2	43	163	49	-	-	-	-	-	-	-
Egremont, . . .	53	64	199	38	-	1 tuberculosi-	-	-	-	-	1 abscess.
Enfield, . . .	1	522	98	-	-	-	-	1 tuberculosi-	-	-	-
Erving, . . .	13	12	51	-	-	-	-	-	-	-	-
Essex, . . .	-	3	75	-	-	-	-	-	-	-	-
EVERETT, . . .	-	-	-	-	-	-	-	-	-	-	-
Fairhaven, . . .	514	620	50	3	-	23 tuberculosi-	-	22 immature,	2 tuberculosi-	-	-
FALL RIVER, . . .	9	4	23	-	-	-	-	-	-	-	-
Falmouth, . . .	4	89	120	-	-	-	-	-	-	-	-
Fitchburg, . . .	590	1,421	245	42	-	3 tuberculosi-	-	10 immature,	1 weak condition,	3 rheu-	-
Florida, . . .	14	39	54	1	-	-	-	-	-	-	-
Foxborough, . . .	16	50	35	1	-	-	-	-	1 tuberculosi-	-	-
Framingham, . . .	109	317	97	2	-	5 tuberculosi-	-	4 immature,	-	-	-
Franklin, . . .	27	33	299	3	-	1 tuberculosi-	-	-	-	-	-
Freetown, . . .	6	22	125	-	-	-	-	-	-	-	-
Gardner, . . .	-	-	-	-	-	-	-	-	-	-	-
Gay Head, . . .	-	-	-	-	-	-	-	-	-	-	-
Georgetown, . . .	11	39	48	-	-	-	-	-	1 hog cholera,	-	-
Gill, . . .	39	80	75	38	-	-	-	-	-	-	-
GLoucester, . . .	58	313	152	26	-	3 tuberculosi-	-	25 immature,	2 tuberculosi-	-	-

Report on Inspection of Slaughtering, Oct. 1, 1914, to Oct. 1, 1915 — Continued.

CITY OR TOWN.	INSPECTED.				CONDEMNED.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Goshen, ...	32	73	35	1	-	-	-	-
Gosnold, ...	2	-	10	7	-	-	-	-
Grafton, ...	94	161	326	16	1 decomposed, . . .	-	-	-
Granby, ...	250	389	124	2	3 tuberculosis, 1 emacia- tion, 1 bruised.	-	1 tuberculosis,	-
Granville, ...	25	70	96	6	-	-	1 tuberculosis,	-
Great Barrington, ...	155	224	343	178	-	1 immature,	-	-
Greenfield, ...	163	520	333	442	-	-	-	-
Greenwich, ...	9	121	93	-	-	-	-	-
Groton, ...	-	3	91	-	-	-	-	-
Groveland, ...	-	4	40	-	-	-	-	-
Hadley, ...	72	139	268	1	1 tuberculosis, 1 tumor, 1 liver flukes,	-	2 liver flukes,	-
Halifax, ...	4	-	10	-	-	-	-	-
Hamilton, ...	-	-	-	-	-	-	-	-
Hampden, ...	14	156	55	3	4 tuberculosis, . . .	-	-	-
Hancock, ...	6	164	11	310	-	-	-	-
Hanover, ...	1	22	140	13	-	-	-	-
Hanson, ...	-	-	67	-	-	-	-	-
Hardwick, ...	41	46	103	15	-	-	-	-
Harvard, ...	25	193	89	3	1 tuberculosis, . . .	1 immature,	-	-
Harwich, ...	12	60	128	-	-	-	-	-
Uatfield, ...	52	275	274	-	17 tuberculosis,	-	-	-

Report on Inspection of Slaughtering, Oct. 1, 1914, to Oct. 1, 1915 — Continued.

CITY OR TOWN.	INSPECTED.				CONDEMNED.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Lenox, ...	350	340	224	30	1 tuberculosi8, 1 difficult parturition. 11 tuberculosi8, ...	2 immature, 22 immature, ...	-	-
LEOMINSTER, ...	97	496	366	16	-	-	12 tuberculosi8, ...	-
Leverett, ...	40	47	200	-	-	-	-	-
Lexington, ...	70	828	1,740	14	5 tuberculosi8, ...	-	1 emaciation, ...	-
Leyden, ...	34	56	55	14	-	-	-	-
Lincoln, ...	4	24	54	-	2 strangulation, ...	3 immature, ...	1 hog cholera, ...	-
Littleton, ...	-	-	-	-	-	-	-	-
Longmeadow, ...	10	18	30	-	-	-	-	-
LOWELL, ...	4	7	719	-	-	-	18 tuberculosi8, 2 hog cholera, 1 emaciation, 1 retained foetus. -	-
Ludlow, ...	96	751	145	11	4 tuberculosi8, ...	-	-	-
Lunenburg, ...	319	777	320	2	9 tuberculosi8, 1 paralysis, 1 dropsy. -	-	1 hog cholera, ...	-
LYNN, ...	162	94	110	-	-	3 immature, ...	1 tuberculosi8, ...	-
Lynnfield, ...	395	864	108	-	1 tuberculosi8, ...	17 immature, ...	5 hog cholera, ...	-
MALDEN, ...	-	-	-	-	-	-	-	-
Manchester, ...	-	-	4	-	-	-	-	-
Mansfield, ...	44	49	357	-	-	-	3 tuberculosi8, ...	-
Marblehead, ...	-	-	92	-	-	-	-	-
Marion, ...	-	3	201	-	-	-	-	-
MARLBOROUGH, ...	14	113	380	1	1 tuberculosi8, 1 injured, . .	2 immature, ...	1 tuberculosi8, ...	-
Marshfield, ...	3	19	107	2	-	-	1 tuberculosi8, ...	-

Report on Inspection of Slaughtering, Oct. 1, 1914, to Oct. 1, 1915 — Continued.

CITY OR TOWN.	INSPECTED.				CONDEMNED.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Natick, ...	3	6	27	-	-	-	-	-
Needham, ...	4	42	1	-	-	-	-	-
New Ashford, ...	25	5	32	61	-	-	1 tumor,	-
NEW BEDFORD, ...	181	313	467	37	13 tuberculosis,	5 immature,	3 hog cholera,	-
New Braintree, ...	34	387	73	2	1 tuberculosis,	1 immature,	-	-
New Marlborough, ...	61	128	169	47	3 tuberculosis,	-	-	-
New Salem, ...	39	64	127	-	-	-	-	-
Newbury, ...	53	613	221	12	1 parturient apoplexy,	24 immature,	-	-
NEWBURYPORT, ...	228	393	141	6	2 tuberculosis,	3 immature,	-	-
NEWTON, ...	-	-	15	-	-	-	-	-
Norfolk, ...	1	8	126	1	-	-	-	-
NORTH ADAMS, ...	228	428	279	25	3 tuberculosis,	1 immature, 1 jaundice, 1 illegally slaughtered,	-	-
North Andover, ...	18	15	106	-	-	-	-	-
North Attleborough, ...	226	233	513	-	5 tuberculosis, 1 parturient apoplexy,	-	1 tuberculosis, 1 abscess,	-
North Brookfield, ...	6	24	88	-	1 tuberculosis,	-	-	-
North Reading, ...	-	-	-	-	-	-	-	-
NORTHAMPTON, ...	181	302	264	3	14 tuberculosis,	1 immature,	1 tuberculosis,	-
Northborough, ...	68	100	43	-	1 tuberculosis,	-	-	-
Northbridge, ...	4	9	17	-	1 tuberculosis,	-	-	-
Northfield, ...	39	68	278	20	-	-	-	-
Norton, ...	42	72	29	-	1 cancer,	-	-	-

Report on Inspection of Slaughtering, Oct. 1, 1914, to Oct. 1, 1915 — Continued.

CITY OR TOWN.	INSPECTED.				CONDEMNED.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
QUINCY, ...	-	-	17	-	-	-	-	-
Randolph, ...	-	4	57	-	-	-	-	-
Raynham, ...	8	67	55	26	-	-	-	-
Reading, ...	265	148	96	-	-	-	-	-
Rehoboth, ...	68	579	103	1	-	-	-	-
REVERE, ...	-	-	19	-	-	-	-	-
Richmond, ...	68	144	150	104	-	-	-	-
Rochester, ...	19	388	152	57	1 tuberculosi,	-	1 tuberculosi,	-
Rockland, ...	-	-	-	-	-	-	-	-
Rockport, ...	31	159	55	1	2 tuberculosi,	-	1 hog cholera,	-
Rowe, ...	22	3	66	24	-	-	-	-
Rowley, ...	28	211	103	1	-	-	-	-
Royalston, ...	23	72	176	100	-	-	-	-
Russell, ...	11	17	29	1	-	-	-	-
Rutland, ...	130	298	179	1	-	-	-	-
SALEM, ...	-	-	-	-	-	-	-	-
Salisbury, ...	-	-	44	-	-	-	-	-
Sandisfield, ...	51	118	63	-	-	-	-	-
Sandwich, ...	9	100	77	-	-	-	-	-
Saugus, ...	4	1	115	-	-	-	8 hog cholera,	-
Savoy, ...	8	29	61	7	-	-	-	-

Report on Inspection of Slaughtering, Oct. 1, 1914, to Oct. 1, 1915 — Continued.

CITY OR TOWN.	INSPECTED.			CONDEMNED.				
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Sunderland, ...	15	53	102	-	-	-	-	-
Sutton, ...	93	335	96	-	1 tuberculosis, ...	-	-	-
Swampscott, ...	-	-	-	-	-	-	-	-
Swansea, ...	275	379	399	63	4 tuberculosis, ...	-	2 tuberculosis, ...	-
TAUNTON, ...	317	416	714	25	12 tuberculosis, 1 retained placenta.	-	2 eczema, ...	-
Templeton, ...	39	113	225	1	-	-	-	-
Tewksbury, ...	385	365	325	-	1 difficult parturition, ...	14 immature, ...	4 hog cholera, ...	-
Tisbury, ...	-	-	-	-	-	-	-	-
Tolland, ...	17	25	68	-	-	-	-	-
Topsfield, ...	7	79	126	2,724	-	8 immature, ...	-	-
Townsend, ...	33	57	124	1	2 tuberculosis, ...	-	-	-
Truro, ...	4	8	55	-	-	-	1 dropsy, ...	-
Tyngsborough, ...	6	6	60	-	-	-	-	-
Tyringham, ...	16	69	71	-	-	-	-	-
Upton, ...	30	95	70	-	-	-	-	-
Uxbridge, ...	57	40	170	-	2 tuberculosis, ...	-	-	-
Wakefield, ...	-	-	271	-	-	-	-	-
Wales, ...	2	4	32	-	-	-	-	-
Walpole, ...	4	15	432	3	-	-	1 peritonitis, 1 emaciation, 2 hog cholera, ...	-
WALTHAM, ...	10	13	133	-	3 tuberculosis, ...	-	-	-
Ware, ...	11	16	68	-	-	-	-	-

Wareham, . . .	7	38	284	-	2 tuberculosis, . . .	-	-	1 tuberculosis, . . .	-
Warren, . . .	37	69	151	5	3 tuberculosis, . . .	-	-	-	-
Warwick, . . .	10	22	77	-	-	-	-	-	-
Washington, . . .	15	73	47	14	-	-	-	-	-
Watertown, . . .	53	628	464	-	-	9 immature, 18 natural death.	-	-	-
Wayland, . . .	3	40	528	2	-	-	-	14 hog cholera, . . .	-
Webster, . . .	4	23	154	1	-	1 immature, . . .	-	-	-
Wellesley, . . .	-	-	-	-	-	-	-	-	-
Wellfleet, . . .	13	4	37	3	1 pyæmia, . . .	-	-	-	-
Wendell, . . .	12	35	24	31	-	-	-	-	-
Wenham, . . .	26	10	81	-	-	-	-	-	-
West Boylston, . . .	33	37	49	-	-	-	-	-	-
West Bridgewater, . . .	20	613	338	13	1 tuberculosis, 1 septicæmia, . . .	35 immature, . . .	-	-	-
West Brookfield, . . .	13	46	125	5	-	-	-	2 jaundice, . . .	-
West Newbury, . . .	9	4	304	-	-	-	-	-	-
West Springfield, . . .	78	605	89	-	-	3 immature, . . .	-	-	-
West Stockbridge, . . .	36	118	167	26	-	-	-	-	-
West Tisbury, . . .	17	43	19	238	-	-	-	-	-
Westborough, . . .	64	72	104	17	1 tuberculosis, . . .	-	-	-	-
Westfield, . . .	96	106	394	2	4 tuberculosis, . . .	-	-	1 tuberculosis, 1 pharyngeal abscesses.	-
Westford, . . .	32	562	324	2	1 tuberculosis, . . .	7 immature, . . .	-	-	-
Westhampton, . . .	50	128	69	-	-	-	-	-	-
Westminster, . . .	30	70	81	7	1 fever, . . .	-	-	-	-
Weston, . . .	100	391	135	-	5 tuberculosis, 1 tumor, . . .	33 immature, . . .	-	1 pneumonia, . . .	-
Westport, . . .	348	840	854	124	2 tuberculosis, . . .	1 immature, . . .	-	6 tuberculosis, . . .	-

Report on Inspection of Slaughtering, Oct. 1, 1914, to Oct. 1, 1915 — Concluded.

CITY OR TOWN.	INSPECTED.				CONDEMNED.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Westwood, ...	35	280	445	-	1 peritonitis, ...	-	1 septicæmia, ...	-
Weymouth, ...	12	316	364	-	1 tuberculosis, ...	-	2 tuberculosis, 1 cardiac dilation, ...	-
Whately, ...	19	6	47	6	-	-	-	-
Whitman, ...	3	13	8	-	-	1 immature, ...	-	-
Wilbraham, ...	38	80	132	11	1 tuberculosis, ...	-	-	-
Williamsburg, ...	24	49	43	-	-	-	-	-
Williamstown, ...	99	627	635	482	6 tuberculosis, 2 pneumonia, ...	1 immature, ...	6 hog cholera, ...	-
Wilmington, ...	103	865	606	-	-	8 immature, 1 injured, ...	9 hog cholera, ...	-
Winchendon, ...	12	72	131	-	2 tuberculosis, 1 pulmonary abscess, ...	2 immature, ...	-	-
Winchester, ...	-	-	-	-	-	-	-	-
Windsor, ...	39	143	72	50	-	-	-	-
Winthrop, ...	-	-	-	-	-	-	-	-
WOBURN, ...	18	865	4,102	-	-	1 immature, ...	6 pneumonia, ...	-
WORCESTER, ...	902	875	1,272	27	19 tuberculosis, 1 injured, ...	26 immature, ...	1 enteritis, 1 hog cholera, ...	-
Worthington, ...	16	50	121	30	-	-	-	-
Wrentham, ...	3	10	102	-	-	-	-	-
Yarmouth, ...	-	4	60	-	-	-	1 tuberculosis, 1 hypertrophy of heart, 1 wounded, ...	-

SUMMARY.

Total number of carcasses inspected, ...	125,283
Cattle, ...	22,279
Calves, ...	60,696
Hogs, ...	34,355
Sheep, ...	7,953
Total number of carcasses passed, ...	123,698
Total number of carcasses condemned, ...	1,585
Cattle, ...	510
Calves, ...	721
Hogs, ...	348
Sheep, ...	6

REASONS FOR CONDEMNATION.	Cattle.	Calves.	Hogs.	Sheep.	Totals.
Tuberculosis, ...	454	3	120	-	577
Actinomycosis, ...	-	-	1	-	1
Immature, ...	-	630	-	-	630
Stillborn, ...	-	1	-	-	1
Hog cholera, ...	-	-	134	-	134
Pneumonia, ...	6	-	14	-	20
Pulmonary congestion, ...	-	2	-	-	2
Enteritis, ...	-	1	2	-	3
Gastritis, ...	-	-	1	-	1
Peritonitis, ...	1	-	1	-	2
Cirrhosis of liver, ...	-	-	1	-	1
Jaundice, ...	-	1	6	-	7
Liver flukes, ...	2	-	2	-	4
Diarrhoea, ...	-	1	-	-	1
Dysentery, ...	-	3	-	-	3
Abscess, ...	-	-	3	1	4
Pharyngeal abscesses, ...	-	-	1	-	1
Pulmonary abscess, ...	1	-	-	-	1
Abdominal abscesses, ...	-	-	1	-	1
Tumor, ...	4	-	1	-	5
Cancer, ...	1	-	1	-	2
Toxæmia, ...	1	-	-	-	1
Septicæmia, ...	3	-	2	-	5
Pyæmia, ...	1	1	-	-	2
Polyarthritis, ...	1	-	-	-	1

REASONS FOR CONDEMNATION.	Cattle.	Calves.	Hogs.	Sheep.	Totals.
Measles, ...	-	-	15	-	15
Eczema, ...	-	-	2	-	2
Rheumatism, ...	-	-	3	-	3
Paralysis, ...	3	-	-	-	3
Dropsy, ...	1	-	1	-	2
Cardiac dilation, ...	-	-	1	-	1
Cardiac hypertrophy, ...	-	-	1	-	1
Uræmia, ...	-	1	-	-	1
Fever, ...	1	-	1	-	2
Mammitis, ...	-	-	1	-	1
Parturient apoplexy, ...	6	-	-	-	6
Difficult parturition, ...	4	-	-	-	4
Retained fœtus, ...	-	-	1	-	1
Retained placenta, ...	1	-	-	-	1
Prolapsus uteri, ...	1	-	-	-	1
Poisoning, ...	-	-	5	-	5
Sexual odor, ...	-	-	1	-	1
Emaciation, ...	6	36	4	-	46
Anæmia, ...	-	-	12	-	12
Weak condition, ...	-	12	1	-	13
Exhaustion, ...	1	2	-	-	3
Wounded, ...	-	-	1	-	1
Bruised, ...	2	2	1	-	5
Injured, ...	3	1	-	-	4
Strangulation, ...	2	1	-	-	3
Natural death, ...	-	22	-	-	22
Improperly bled, ...	-	1	-	-	1
Improperly prepared, ...	-	-	3	-	3
Inspector not present, ...	3	1	-	-	4
Illegally slaughtered, ...	-	1	-	-	1
Unstamped, ...	-	-	1	5	6
Decomposed, ...	1	-	-	-	1
Totals, ...	510	721	348	6	1,585

APPENDIX.

REPORT ON DAIRY PRODUCTS TO THE THIRTY-SECOND CONVENTION OF THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS AT WASHINGTON, D. C., NOV. 15, 1915.

By LEWIS I. NURENBERG, REFEREE, ASSISTANT ANALYST, MASSACHUSETTS STATE DEPARTMENT OF HEALTH.

A study and compilation of figures have been made of the sour serum method for the detection of added water in milk. In this work the referee has had the co-operation of Messrs. J. T. Keister, associate referee, and L. W. Ferris of the Bureau of Chemistry, United States Department of Agriculture, Washington, D. C., and Messrs. George B. Taylor, analyst, J. R. Keeney, assistant chemist, and J. S. Slack, dairy inspector of the Louisiana State Board of Health.

The referee has obtained figures of over 660 samples of known purity milk from individual cows, and 49 samples from herds. These samples are representative of practically all breeds of cows mentioned in the 1914 report, and of such influencing conditions as variation in season and lactation period. More than one-half of the total number represent low grade milk.

The methods of preparation and analysis of the serum are as follows:—

*Preparation of the Sour Serum.*¹ — Allow the milk to sour spontaneously, and filter.

Refraction of Sour Serum. — Determine the index of refraction of the clear serum at 20° C. by means of the Zeiss Immersion Refractometer. A refraction below 38.3 indicates added water.

*Ash of Sour Serum.*² — Transfer 25 cubic centimeters of the serum to a flat-bottomed platinum dish and evaporate to dryness over the water bath. Then heat the contents of the dish over a small flame (to avoid sputtering) until charred. Place the dish in an electric muffle, with pyrometer connected, and ash at a heat not greater than 500° C. or 900° F. Cool and weigh. Result is expressed in grams per 100 cubic centimeters. An ash below 0.730 indicates added water.

In the original article as described by A. Burr and F. M. Berberich² the authors have outlined the following method. Measure 50 cubic centimeters of the serum into a platinum dish, evaporate to dryness and carbonize over a low flame. Extract the char with hot water, burn the insoluble residue, add the solution to this ash, evaporate to dryness, ignite at a low temperature and weigh. Experience has shown, however, with the exercise of care and an accurate pyrometer that the former stated method is as accurate as the latter, and involves less manipulation.

¹ Matthes and Muller, *Z. Öffentl. Chem.*, 9 (1903), 173.

² A. Burr and F. M. Berberich, *Chem.-Ztg.*, 32, 617-18.

Table No. 1 contains the refractions of the sour serum of 660 samples of known purity milk from individual cows and 49 samples from herds. In the case of the individual cows the variation in the readings extends from 38.3 to 45.9. The greatest percentage of samples (25.2 per cent.) refract between 41 and 42. There appears to be a certain uniformity each side of this medial point. The percentage of samples refracting between 40 and 41 and 42 and 43 is practically the same (from 18 to 20 per cent.); between 39 and 40 and 43 and 44 the percentage is from 12 to 13.5 per cent., while from 38.3 to 39 and 44 to 45 the percentage is 4 to 5 per cent.

In the herds the largest percentage of samples (75 per cent.) refract between 41 and 43. Between 40 and 41 and 43 and 44 the percentage is from 10 to 12. As would be expected no samples were found refracting at the maximum (45.9) or minimum (38.3) limits.

TABLE NO. 1. — *Variation in Refractive Indices of Sour Serum of Known Purity Milk.*

660 samples from individual cows; 49 samples from herds.

Refractive Indices.

REFRACTIVE INDEX. 20° C.	INDIVIDUAL COWS.		REFRACTIVE INDEX. 20° C.	HERDS.	
	Number of Samples.	Per Cent. of Samples.		Number of San ples.	Per Cent. of Samples.
38.3-38.9, ...	34	5.2	38.3-38.9, ...	-	-
39-39.9, ...	81	12.3	39-39.9, ...	2	4.1
40-40.9, ...	121	18.3	40-40.9, ...	6	12.3
41-41.9, ...	167	25.2	41-41.9, ...	18	36.7
42-42.9, ...	133	20.2	42-42.9, ...	18	36.7
43-43.9, ...	90	13.6	43-43.9, ...	5	10.2
44-44.9, ...	27	4.1	44-44.9, ...	-	-
45-45.9, ...	7	1.1	45-45.9, ...	-	-
	660	100.0		49	100.0

Following is the graphic representation of the figures given in Table No. 1. The curves cross at the 20 per cent. line with a refractive index of 40.8, and again at the 15 per cent. line with a refractive index of 43.3.

*Variation in Refractive Indices of Sour Serum of
Known Purity Milk*

— Milk from Individual Cows 660 Samples
--- " " Herds 49 "

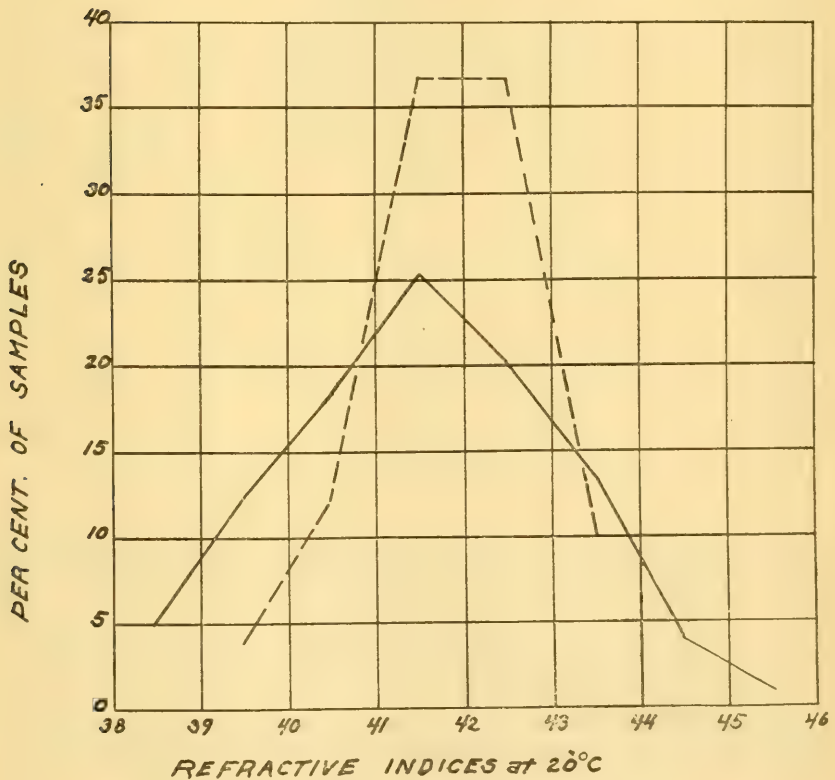


TABLE NO. 2. — *Variation in Ash of Sour Serum of Known Purity Milk.*

504 samples from individual cows; 35 samples from herds.

Ash of Sour Serum.

REFRACTIVE INDEX. 20° C.	INDIVIDUAL COWS.		REFRACTIVE INDEX. 20° C.	HERDS.	
	Number of Samples.	Per Cent. of Samples.		Number of Samples.	Per Cent. of Samples.
0.730-0.739, . . .	41 41	8.2	0.730-0.739, . . .	- -	-
0.740-0.749, . . .	54 } 88	17.3	0.740-0.749, . . .	1 1	2.9
0.750-0.759, . . .	34 } 88	17.3	0.750-0.759, . . .	2 } 6	17.1
0.760-0.769, . . .	51 } 89	17.7	0.760-0.769, . . .	4 } 6	17.1
0.770-0.779, . . .	38 } 89	17.7	0.770-0.779, . . .	2 } 8	22.8
0.780-0.789, . . .	52 } 97	19.3	0.780-0.789, . . .	6 } 8	22.8
0.790-0.799, . . .	45 } 97	19.3	0.790-0.799, . . .	6 } 15	42.9
0.800-0.809, . . .	51 } 88	17.3	0.800-0.809, . . .	9 } 15	42.9
0.810-0.819, . . .	37 } 88	17.3	0.810-0.819, . . .	4 } 5	14.3
0.820-0.829, . . .	26 } 35	7.0	0.820-0.829, . . .	1 } 5	14.3
0.830-0.839, . . .	9 } 35	7.0		35 35	100.0
0.840-0.849, . . .	17 } 24	4.8			
0.850-0.859, . . .	7 } 24	4.8			
0.860-0.869, . . .	16 } 23	4.6			
0.870-0.879, . . .	7 } 23	4.6			
0.880-0.889, . . .	7 } 11	2.2			
0.890-0.899, . . .	4 } 11	2.2			
0.900-0.909, . . .	4 } 4	0.8			
0.910-0.919, . . .	- } 4	0.8			
0.920-0.929, . . .	1 } 2	0.4			
0.930-0.939, . . .	1 } 2	0.4			
0.940-0.949, . . .	2 2	0.4			
	504 504	100.0			

Table No. 2 presents the sour serum ash figures of 504 samples of known purity milk from individual cows, and 35 samples from herds. In the individual cows only 8.2 per cent. of the ash figures extended between the minimum limit 0.730 and 0.740, while 71.6 per cent. were between 0.740 and 0.820. Sixteen and four tenths per cent. of the figures were between 0.820 and 0.880, and 3.8 per cent. between 0.880 and 0.950. In the milk from herds no samples were found with ash figures from the minimum limit 0.730 to 0.739, or from 0.830 to the maximum limit 0.949. Two and nine tenths per cent. of the ash figures were between 0.740 and 0.749; 82.8 per cent. were between 0.750 and 0.810, and 14.3 per cent. were between 0.810 and 0.830.

The variation of the sour serum ash figures of Table No. 2 are shown in the following plot. The curves cross at the 17.5 per cent. line with an ash percentage of 0.761.

VARIATION IN ASH OF SOUR SERUM OF KNOWN PURITY MILK



TABLE NO. 3. — *Variation in Refractive Indices of Known Purity Milk.**Refractive Indices.*

	FROM INDIVIDUAL COWS.			FROM HERDS.	
	Number of Samples.	Per Cent. of Samples.		Number of Samples.	Per Cent. of Samples.
38.0-38.4, ...	20	3.0 3.0	38.0-38.4, ...	—	1. 2.1
38.5-38.9, ...	14	2.1 5.1	38.5-38.9, ...	—	— —
39.0-39.4, ...	45	6.8 11.9	39.0-39.4, ...	—	— —
39.5-39.9, ...	36	5.5 17.4	39.5-39.9, ...	—	— —
40.0-40.4, ...	60	9.1 26.5	40.0-40.4, ...	2	4.1 4.1
40.5-40.9, ...	61	9.2 35.7	40.5-40.9, ...	4	8.2 12.3
41.0-41.4, ...	87	13.2 48.9	41.0-41.4, ...	2	4.1 16.4
41.5-41.9, ...	80	12.1 61.0	41.5-41.9, ...	8	16.3 32.7
42.0-42.4, ...	87	13.2 74.2	42.0-42.4, ...	10	20.4 53.1
42.5-42.9, ...	46	7.0 81.2	42.5-42.9, ...	11	22.4 75.5
43.0-43.4, ...	52	7.9 89.1	43.0-43.4, ...	7	14.3 89.8
43.5-43.9, ...	38	5.8 94.9	43.5-43.9, ...	4	8.2 98.0
44.0-44.4, ...	18	2.7 97.6		1	2.0 100.0
44.5-44.9, ...	9	1.4 99.0			
45.0-45.4, ...	5	0.7 99.7			
45.5-45.9, ...	2	0.3 100.0			
	660	100.0		49	

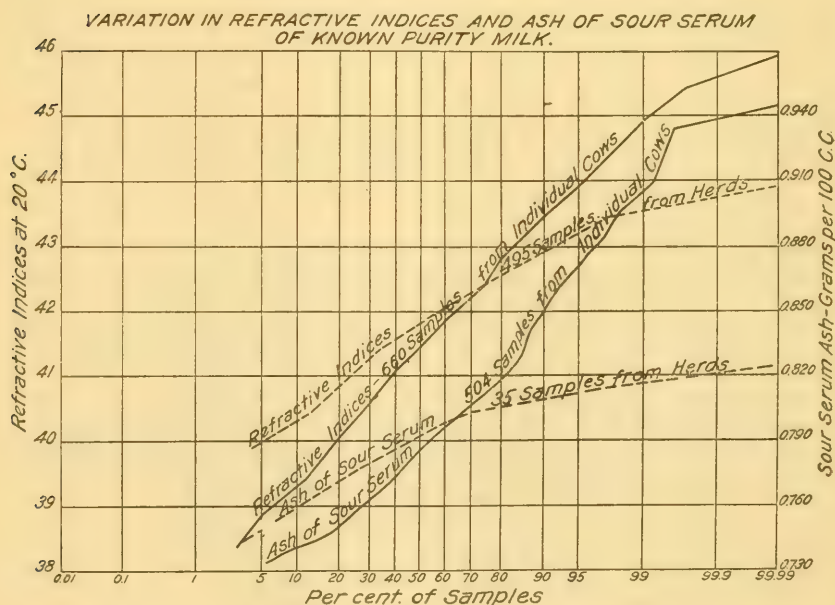
¹ Figures arranged for the arithmetic probability curve.

TABLE NO. 4. — *Variation in Ash of Sour Serum of Known Purity Milk.**Ash of Sour Serum.*

	FROM INDIVIDUAL COWS.			FROM HERDS.	
	Number of Samples.	Per Cent. of Samples.		Number of Samples.	Per Cent. of Samples.
0.730-0.734, ...	30	5.9 5.9	0.730-0.734, ...	-	- -
0.735-0.739, ...	11	2.2 8.1	0.735-0.739, ...	-	- -
0.740-0.744, ...	33	6.5 14.6	0.740-0.744, ...	1	2.9 2.9
0.745-0.749, ...	21	4.1 18.7	0.750-0.754, ...	2	5.7
0.750-0.754, ...	19	3.8 22.5	0.760-0.764, ...	2	5.7 14.3
0.755-0.759, ...	15	3.0 25.5	0.765-0.769, ...	2	5.7
0.760-0.764, ...	33	6.5 32.0	0.770-0.774, ...	1	2.9 22.9
0.765-0.769, ...	18	3.6 35.6	0.775-0.779, ...	1	2.9
0.770-0.774, ...	26	5.2 40.8	0.780-0.784, ...	2	5.7 31.5
0.775-0.779, ...	12	2.4 43.2	0.785-0.789, ...	4	11.4
0.780-0.784, ...	31	6.1 49.3	0.790-0.794, ...	4	11.4 54.3
0.785-0.789, ...	21	4.1 53.4	0.795-0.799, ...	2	5.7
0.790-0.794, ...	25	4.9 58.3	0.800-0.804, ...	4	11.4 71.4
0.795-0.799, ...	20	4.0 62.3	0.805-0.809, ...	5	14.3
0.800-0.804, ...	32	6.3 68.6	0.810-0.814, ...	4	11.4 97.1
0.805-0.809, ...	19	3.8 72.4	0.820-0.824, ...	1	2.9 100.0
0.810-0.814, ...	27	5.4 77.8			
0.815-0.819, ...	10	2.0 79.8			
0.820-0.824, ...	20	4.0 83.8			
0.825-0.829, ...	6	1.2 85.0			
0.830-0.834, ...	7	1.4 86.4			
0.835-0.839, ...	2	0.4 86.8			
0.840-0.844, ...	8	1.6 88.4			
0.845-0.849, ...	9	1.8 90.2			
0.850-0.854, ...	3	0.6 90.8			
0.855-0.859, ...	4	0.8 91.6			
0.860-0.864, ...	8	1.6 93.2			
0.865-0.869, ...	8	1.6 94.8			
0.870-0.874, ...	5	1.0 95.8			
0.875-0.879, ...	2	0.4 96.2			
0.880-0.884, ...	4	0.8 97.0			
0.885-0.889, ...	3	0.6 97.6			
0.890-0.894, ...	1	0.2 97.8			
0.895-0.899, ...	3	0.6 98.4			
0.900-0.904, ...	3	0.6 99.0			
0.905-0.909, ...	1	0.2 99.2			
0.910-0.914, ...	-	- -			
0.915-0.919, ...	-	- -			
0.920-0.924, ...	11	0.2 99.4			
0.925-0.929, ...	-	- -			
0.930-0.934, ...	1	0.2 99.6			
0.935-0.939, ...	-	- -			
0.940-0.944, ...	2	0.4 100.0			
	504	100.0			

If the samples were fairly representative and if the variable follows the law of probability, the resulting curve will be a straight line. Although these lines are not straight, they are so nearly straight that it can be said that sufficiently representative samples have been taken to draw definite conclusions.

The medial line (50 per cent. line) shows that 50 per cent. of the samples had refractive indices below 41.4 from individual cows, and 41.8 from herds. The curves for the refractive indices of the herds and individual cows cross at the 73 per cent. point with a refractive index of 42.4. The medial line also shows that in 50 per cent. of the samples the sour serum ash was below 0.784 from individual cows, and 0.793 from herds. The curves for the sour serum ash of

the herds and individual cows cross at the 68 per cent. line with the sour serum ash of 0.802.

Table No. 5 contains the results submitted by Mr. L. W. Ferris. His experimental work has shown conclusively that the time of spontaneous souring affects the sour serum ash. In the cases of partial souring the sour serum ash figure is lower than the acetic serum ash, which of course should not be. Unless the sample is sufficiently sour, some of the calcium salt is precipitated with the casein, and the sour serum ash is very liable to be low, as shown in Table No. 5. The minimum sour serum ash figure reported as 0.671 on longer souring was raised to 0.722, which corresponds to the figure obtained by the acetic serum after being multiplied by 1.02.

TABLE No. 5. — *Data for Detection of Added Water to Milk.*

[All samples except the first 8 represent single milkings from individual cows, September-October, 1915.]

BREED.	Age of Cow.	Time since Calving.	Amount of Milk (Pounds).	SPONTANEOUS SERUM.			ACETIC ACID SERUM.			Remarks.
				Refrac- tion at 20° C.	Ash (Grams per 100 c. c. Serum).	Acidity (Grams Lactic Acid per 100 c. c. Serum).	Refrac- tion at 20° C.	Ash, X (Grams per 100 c. c. Serum).	Acidity (Grams Lactic Acid per 100 c. c. Serum).	
-	-	-	-	41.6	.798	-	-	-	-	Market milk.
-	-	-	-	42.0	.766	.472	42.3	.788	.727	Market milk.
-	-	-	-	41.9	.773	.365	42.3	.796	.691	Market milk.
-	-	-	-	41.5	.785	.596				Longer souring.
-	-	-	-	40.7	.782	.508	42.0	.780	.657	Market milk.
-	-	-	-	41.1	.781	.601				Longer souring.
-	-	-	-	41.5	.775	.443	41.7	.783	.695	Market milk.
-	-	-	-	40.7	.776	.508				Longer souring.
Holstein,	4 years, 8 months,	6 months,	20.00	39.7	.802	.639	40.2	.804	.634	Longer souring.
Holstein,	4 years, 8 months,	6 months,	20.00	39.9	.802	.675				
Holstein,	4 years, 8 months,	6 months,	20.00	38.7	.801	.497	39.4			
Holstein,	4 years, 8 months,	6 months,	20.00	39.9	.802	.675		.814	.733	Longer souring.
Holstein,	4 years, 8 months,	6 months,	20.00	39.4	.803	.695				
Holstein,	4 years, 8 months,	6 months,	12.50	38.7	.796	.727	39.7			
Holstein,	4 years, 8 months,	6 months,	12.50	39.1	.811	.713		.801	.790	Longer souring.
Holstein,	4 years, 8 months,	6 months,	18.00	39.7	.812	.675	40.2	.815	.760	-

TABLE No. 5. — *Data for Detection of Added Water to Milk* — Continued.

BREED.	Age of Cow.	Time since Calving.	Amount of Milk (Pounds).	SPONTANEOUS SERUM.			ACETIC ACID SERUM.			Remarks.
				Refrac- tion at 20° C.	Ash (Grams per 100 c. c. Serum).	Acidity (Grams Lactic Acid per 100 c. c. Serum).	Refrac- tion at 20° C.	Ash X (Grams per 100 c. c. Serum).	Acidity (Grams Lactic Acid per 100 c. c. Serum).	
Holstein.	2 years, 11 months.	5 months.	19.21	Cloudy. ¹	.717	.581	41.8	.722	.733	Longer souring.
Holstein.	2 years, 11 months.	5 months.	19.21	41.0	.717	.648				
Holstein.	2 years, 11 months.	5 months.	19.21	40.7	.709	.497				
Holstein.	2 years, 11 months.	5 months.	19.21	40.7	.711	.544	41.2	.709	.779	Longer souring.
Holstein.	2 years, 11 months.	5 months.	19.21	40.7	.702	.596				
Holstein.	2 years, 11 months.	5 months.	12.80	40.7	.671	.554				
Holstein.	2 years, 11 months.	5 months.	12.80	40.0	.687	.653	40.7	.722	.767	Longer souring.
Holstein.	2 years, 11 months.	5 months.	12.80	40.2	.722	.713				
Holstein.	2 years, 11 months.	5 months.	19.00	41.7	.699	.544	42.0	.717	.751	
Holstein.	5 years.	3 months.	20.70	40.7	.757	.648	41.2	.760	-	-
Holstein.	5 years.	3 months.	23.20	41.2	.757	.770	41.6	.752	-	-
Holstein.	9 years.	9 months.	11.80	41.4	.745	.563	42.0	.746	-	-
Holstein.	9 years.	9 months.	16.80	40.7	.737	.648	41.7	.736	-	-
Holstein.	9 years.	9 months.	13.00	40.1	.732	.657	41.1	.734	-	-
Holstein.	5 years.	4 months.	21.50	41.3	.724	.535	41.7	.714	-	-
Holstein.	5 years.	4 months.	27.50	40.9	.755	.713	41.5	.740	-	-
Holstein.	6 years.	7 months.	12.30	42.5	.739	.619	41.2	.773	-	-
Holstein.	6 years.	7 months.	19.60	39.4	.721	.554	40.1	.734	-	-

Holstein, . . .	6 years,	.	.	7 months,	15.50	Cloudy.	.709	.488	39.8	.716	-
Holstein, . . .	6 years,	.	.	8 months,	8.60	41.0	.769	.555	41.9	.767	-
Holstein, . . .	6 years,	.	.	8 months,	-	41.5	.712	.666	40.8	.726	-
Holstein, . . .	4 years,	.	.	2 months,	20.00	40.7	-	-	40.3	.733	-
Grade Holstein, .	8-9 years,	.	.	Nearly dry,	6.00	40.7	.813	.742	40.7	.830	-
Grade Holstein, .	8-9 years,	.	.	Nearly dry,	6.00	40.7	.797	.665	40.9	.782	-
Grade Holstein, .	-	-	-	3 months,	12.00	41.7	.729	.657	41.8	.741	-
Grade Holstein, .	-	-	-	3 months,	12.00	41.3	.732	.653	41.3	.735	-
Grade Holstein, .	8-9 years,	.	.	10 months,	4.00	42.7	.807	.675	42.7	.811	-
Grade Holstein, .	6 years,	.	.	10 months,	16.80	38.5	.794	.517	38.7	.796	-
Grade Holstein, .	6 years,	.	.	10 months,	17.70	41.4	.816	.734	39.2	.818	-
Grade Holstein, .	-	-	-	8 months,	5.40	41.4	.924 ²	.657	Cloudy. ³	.877	-
Grade Holstein, .	-	-	-	8 months,	8.00	42.6	.862	.716	43.7	.864	-
Grade Holstein, .	6 years,	.	.	3 weeks,	19.00	40.3	.822	.733	42.7	.816	-
Grade Holstein, .	9 years,	.	.	4 months,	7.00	39.1	.776	.619	38.0	.775	-
Grade Holstein, .	9 years,	.	.	4 months,	10.00	39.2	.797	.657	38.8	.783	-
Grade Holstein, .	9 years,	.	.	4 months,	7.80	37.9	.766	.517	37.8	.769	-
Grade Holstein, .	2 years,	.	.	11 months,	6.00	39.9	.744	.601	40.5	.741	-
Grade Holstein, .	2 years,	.	.	11 months,	8.20	40.0	.767	.657	40.0	.745	-
Grade Holstein, .	2 years,	.	.	11 months,	7.40	40.5	.745	.657	40.9	.753	-
Durham, . . .	5 years,	.	.	2 months,	12.00	40.7	.774	.742	41.2	.775	-
Durham, . . .	2½ years,	.	.	1 month,	-	41.0	.751	.704	41.3	.756	-

¹ Could not get spontaneous serum clear enough to read.

² Extra high results may have been due to slow filtering of very small amount of serum.

³ Could not get filtrate clear enough to read.

TABLE No. 5. — *Data for Detection of Added Water to Milk* — Concluded.

BREED.	Age of Cow.	Time since Calving.	Amount of Milk (Pounds).	SPONTANEOUS SERUM.			ACETIC ACID SERUM.			Remarks.
				Refrac- tion at 20° C.	Ash (Grams per 100 c. c. Serum).	Acidity (Grams Lactic Acid per 100 c. c. Serum).	Refrac- tion at 20° C.	Ash X (Grams per 100 c. c. Serum).	Acidity (Grams Lactic Acid per 100 c. c. Serum).	
Durham, . . .	6-7 years, . .	3 weeks, . .	16.00	41.9	.756	.751	42.5	.736	-	-
Durham, . . .	5 years, . . .	3 weeks, . .	16.00	41.5	.803	.704	41.8	.785	-	-
Black Polled, . .	2½ years, . . .	2 weeks, . .	12.00	39.7	.763	.666	40.1	.786	-	-
Black Polled, . .	2½ years, . . .	2 weeks, . .	12.00	41.7	.762	.733	42.2	.814	-	-
Grade Guernsey, .	3 years, . . .	1 week, . .	12.00	41.4	.772	.779	42.1	.755	-	-
Minimum, . . .	-	-	-	37.9	.671	-	38.0	.709	-	-
Maximum, . . .	-	-	-	42.7	.924	-	43.7	.877	-	-
Mean, ...	-	-	-	40.6	.765	-	41.0	.769	-	-

Acetic acid serum obtained by adding 2 cubic centimeters of 25 per cent. acetic acid to 100 cubic centimeters milk (per Bulletin 107). Result multiplied by 1.02 to make them comparable to those on the spontaneous serum. The results obtained by both methods are about the same. The degree of souring of the spontaneous serum appears to make no difference in either the ash or refraction, although clearer serums were obtained by allowing the sample to stand until the whey and curd had separated. In some cases it was impossible to get a clear serum. The spontaneous souring involves less work than the acetic acid method, and in most cases the spontaneous serum is about as clear as that obtained by the acetic acid method.

One sample gave a refraction of 37.9 (cow No. 15) on the spontaneous serum, and samples from 4 different cows (Nos. 2, 5, 6 and 7) gave an ash of serum below 0.73.

Table No. 6 contains the results submitted by Mr. J. T. Keister, associate referee. In this table there are three abnormal sour serum ash figures. The referee is of the opinion that in each case the milk was not thoroughly sour. If the sample is thoroughly sour, a clear serum will be obtained which will contain all the mineral matter.

TABLE No. 6. — *Analysis of Milk from Individual Cows, September–October, 1915.*

Breed.	Age of Cow.	Time since Calving.	Amount of Milk (Pounds).	Fat by Rose-Gottlieb (Per Cent.).	Fat by Babcock Method (Per Cent.).	Solids not Fat, Gravimetric (Per Cent.).	Solids not Fat, Calculated (Per Cent.).	Refraction of Sour Serum at 20° C.	Ash of Sour Serum (Grams per 100 c. c.).	Ash in Milk (Per Cent.).
Holstein,	4½ years,	6 months,	15.20	3.82	3.85	7.96	7.86	39.2	.748	.750
Holstein,	4½ years,	6 months,	12.50	3.71	3.80	7.78	7.78	39.0	.790	.740
Holstein,	4½ years,	6 months,	18.00	2.79	2.80	8.09	8.00	40.0	.773	.760
Holstein,	2 years, 11 months,	5 months,	16.40	4.22	4.30	8.18	8.12	40.9	.678	.657
Holstein,	2 years, 11 months,	5 months,	12.08	3.88	3.95	8.12	8.00	40.3	.668	.660
Holstein,	2 years, 11 months,	5 months,	19.00	2.55	2.70	8.52	8.35	40.8	.704	.669
Holstein,	5 years,	3 months,	20.70	3.02	3.10	8.33	8.48	40.9	.753	.730
Holstein,	5 years,	3 months,	23.20	3.01	3.10	8.44	8.33	41.3	.764	.720
Holstein,	9 years,	9 months,	11.80	3.14	3.15	8.74	8.53	41.1	.754	.730
Holstein,	9 years,	9 months,	16.80	2.48	2.50	8.76	8.50	40.8	.756	.710
Holstein,	9 years,	9 months,	13.00	2.80	2.80	8.78	8.46	41.1	.745	.680
Holstein,	5 years,	4 months,	21.50	3.07	3.15	8.35	8.41	40.4	.769	.730
Holstein,	—	4 months,	27.50	3.02	3.15	8.36	8.45	40.9	.743	.700
Holstein,	6 years,	7 months,	12.30	3.77	3.90	8.64	8.40	41.3	.787	.706

TABLE No. 6. — *Analysis of Milk from Individual Cows, September–October, 1915* — Concluded.

BREED.	Age of Cow.	Time since Calving.	Amount of Milk (Pounds).	Fat by Rose-Gottlieb (Per Cent.).	Fat by Babcock Method (Per Cent.).	Solids not Fat, Gravimetric (Per Cent.).	Solids not Fat, Calculation (Per Cent.).	Refraction of Serum at 20° C.	Ash of Serum (Grams per 100 c. c.).	Ash in Milk (Per Cent.).
Holstein,	6 years,	7 months,	19.60	3.00	3.05	8.13	7.96	39.2	.740	.680
Holstein,	6 years,	7 months,	15.50	—	4.20	—	8.05	38.0	.731	.664
Holstein,	6 years,	8 months,	8.60	3.31	3.30	8.76	8.56	41.9	.770	.690
Holstein,	6 years,	8 months,	10.00	3.21	3.30	8.53	8.31	40.4	.731	.740
Holstein,	4 years,	2 months,	20.00	—	3.75	—	8.10	39.7	.729	.710
Grade Holstein,	8 or 9 years,	8 or 9 months,	8.00	3.47	3.20	8.56	—	40.9	.853	.730
Grade Holstein,	8 or 9 years,	8 or 9 months,	8.00	3.72	3.50	8.63	—	—	—	—
Grade Holstein,	3 years,	3 months,	16.00	—	4.00	—	8.26	40.4	.731	—
Grade Holstein,	—	3 months,	16.00	—	3.60	—	8.59	42.7	.739	—
Grade Holstein,	8 or 9 years,	8 or 10 months,	4.00	—	7.70	—	8.99	43.2	.808	—
Grade Holstein,	6 years,	10 months,	16.80	3.40	3.45	7.49	7.54	41.8	.801	.750
Grade Holstein,	6 years,	10 months,	17.70	2.84	2.95	7.65	7.71	41.7	.813	.730
Grade Holstein,	—	8 months,	5.40	—	4.80	—	9.30	41.8	.882	—
Grade Holstein,	—	8 months,	8.00	—	4.40	—	9.08	42.6	.898	—
Grade Holstein,	6 years,	3 months,	19.00	—	3.10	—	8.97	41.1	.832	—
Grade Holstein,	9 years,	4 months,	7.00	1.10 ¹	1.10	7.48	7.37	40.2	.781	.680
Grade Holstein,	9 years,	4 months,	10.00	3.81	3.80	7.79	7.58	40.9	.806	.700
Grade Holstein,	9 years,	4 months,	7.80	3.09	3.10	7.60	7.51	38.4	.790	.720

Grade Holstein,	.	2 years,	.	.	11 months,	.	6.00	-	4.20	-	8.09	40.0	.760	-
Grade Holstein,	.	2 years,	.	.	11 months,	.	8.20	3.54	3.45	8.22	8.21	41.4	.554	.680
Grade Holstein,	.	2 years,	.	.	11 months,	.	7.40	3.37	3.45	8.47	8.36	41.1	.770	.696
Grade Durham,	.	5 years,	.	.	2 months,	.	12.00	-	3.75	-	8.46	40.8	.782	-
Grade Durham,	.	2½ years,	.	.	1 month,	.	10.00	-	3.50	-	8.55	41.0	.745	-
Grade Durham,	.	6 years,	.	.	3 months,	.	16.00	-	3.65	-	8.98	41.8	.811	-
Grade Durham,	.	5 years,	.	.	3 months,	.	16.00	-	3.80	-	8.55	41.8	.761	-
Black Polled, .	.	2½ years,	.	.	2 months,	.	12.00	3.18	3.25	8.35	8.26	40.4	.791	.767
Black Polled, .	.	2½ years,	.	.	2 months,	.	12.00	3.10	3.20	8.86	8.68	41.9	.814	.790
Grade Guernsey,	.	3 years,	.	.	1 month,	.	12.00	-	3.85	-	8.68	41.1	.779	-
Grade Jersey,	.	20 (about),	.	.	3 months,	.	8.00	2.83	2.80	-	8.33	40.4	.806	-
Grade Jersey,	.	10 years,	.	.	1 month,	.	12.00	-	4.80	-	7.81	40.1	.816	.750
Grade Durham,	.	5 years,	.	.	1 month,	.	10.00	-	6.60	-	8.57	40.6	.869	-
Grade Durham,	.	10 (about),	.	.	1 month,	.	10.00	-	7.90	-	8.85	43.0	.832	-
-	-	-	-	-	-	-	-	-	4.60	-	8.42	40.7	.790	-

1 Sample taken by milker; probably represents first portion of the milking.

TABLE No. 7. — *Milk Samples from Fagot Dairy, Metairie Ridge, Jefferson Parish.*

[Analyses by J. R. Keeny and J. S. Slack, from the laboratory of George B. Taylor, analyst of the Louisiana State Board of Health.]

BREED.	Age (Years).	Quantity Milk (Pounds).	Time since Calving (Months).	Specific Gravity at 15° C.	Total Solids by Table.	Fat.	SOUR SERUM.	
							Ash.	Refractive Index.
Grade Jersey, ...	8	6	9	1.0354	14.88	5.00	0.898	45.2
Brown Grade Jersey, ...	8	16	6	1.0344	15.11	5.40	0.876	43.6
Holstein, ...	10	16	½	1.0317	15.16	6.00	0.805	44.2
Grade Jersey, ...	3	9	2	1.0328	14.95	5.60	0.788	43.4
Grade Jersey, ...	5	14	5	1.0315	15.71	6.50	0.744	43.1
Grade Jersey, ...	7	16	2	1.0325	14.63	5.40	0.787	43.9
Grade Jersey, ...	3	9	2	1.0302	14.89	6.10	0.707	42.3
Jersey, ...	6	14	2	1.0260	—	8.20	0.880	43.1
Jersey, ...	12	10	6	1.0298	15.64	6.80	0.840	43.4
Grade Jersey, ...	8	10	6	1.0295	13.15	4.80	0.842	41.5
Brown Grade Jersey, ...	5	18	5	1.0298	15.40	6.60	0.844	44.4
Red Grade Jersey, ...	10	17	8	1.0293	13.82	5.40	0.874	43.6
Jersey, ...	6	25	2	1.0315	14.14	5.20	0.744	42.0
Holstein, ...	9	12	10	1.0316	11.75	3.20	0.813	42.0
Jersey, ...	7	10	10	1.0321	—	7.40	0.902	43.6
Grade Jersey, ...	8	16	5	1.0351	14.57	4.80	0.866	43.6
Grade Durham, ...	8	18	4	1.0329	14.01	4.80	0.795	44.2
Grade Jersey, ...	5	12	2	1.0322	14.55	5.40	0.820	41.7
Grade Jersey, ...	8	11	4	1.0345	11.52	2.40	0.708	42.8
Composite of 6 Grade Jerseys, ...	—	58	—	1.0302	15.01	6.20	0.810	43.4
4 Jerseys, 12 Grade Jerseys, 2 Holsteins, 1 Durham, ...	—	289	—	1.0315	13.89	5.00	0.805	42.8

TABLE No. 8. — *Composition of 8 Samples of Herd Milk.*

(Arranged in order of total solids.)

NUMBER OF SAMPLE.	Total Solids.	Fat.	Solids not Fat.	Protein.	Sugar.	Ash.	Copper Serum Refraction at 20° C.		Sour Serum. Refraction at 20° C.		Ash.
							Copper Serum Refraction at 20° C.		Refraction at 20° C.		
1,	13.02	4.60	8.42	—	—	—	—		40.7		0.790
2,	12.95	4.10	8.85	3.29	4.74	0.70	37.4		40.4		0.774
3,	12.62	3.40	9.22	3.04	5.01	0.76	38.5		41.0		0.816
4,	12.60	3.35	9.25	2.33	5.04	0.78	38.7		41.9		0.832
5,	12.57	4.00	8.57	3.18	4.82	0.68	37.2		41.5		0.766
6,	12.24	3.55	8.69	3.34	4.65	0.74	36.7		—		0.808
7,	12.13	3.35	8.78	2.96	4.72	0.80	36.8		41.3		—
8,	11.67	3.40	8.27	2.84	4.51	0.77	36.3		39.1		0.804
Highest,	13.02	4.60	9.25	3.29	5.04	0.80	38.7		41.9		0.832
Lowest,	11.67	3.35	8.27	2.33	4.51	0.68	36.3		39.1		0.766
Average,	12.48	3.72	8.76	3.00	4.78	0.75	37.4		40.8		0.799
Average of 67 samples from herds reported in 1914, .	12.83	4.06	8.77	—	—	—	37.9		41.7		0.798

There is no relation between the refraction of the sour serum and the sour serum ash, since these figures depend upon different milk constituents. When both of these figures fall below the lowest limits established for pure milk (38.3 and 0.730), it is absolute proof of the presence of added water, and all possibility of the sample being abnormal milk from a sick cow is removed.

In the determination of ash of sour serum there is less than 2 grams of organic matter to be burned, and the influence of combustion upon the 190 milligrams of ash is very slight.

The refractive index of the sour serum occurs half way between the copper and acetic indices. Where a milk has partially soured the copper serum reading will be higher, and the acetic serum lower than would be given by the same milk before souring. In such cases the sour serum is the only reliable one to be made.

Six years' experience with the refractive index and four years' with the sour serum ash have shown these methods to be invaluable. In all doubtful cases the sour serum ash has served as a court of last resort.

DIVISION OF COMMUNICABLE DISEASES.

DIVISION OF COMMUNICABLE DISEASES.

DIRECTOR, EUGENE R. KELLEY, M.D.

DR. ALLAN J. McLAUGHLIN, *Commissioner of Health.*

SIR:— I have the honor to submit the following report of the Division of Communicable Diseases for the year ending Nov. 30, 1915.

Respectfully submitted,

• EUGENE R. KELLEY,

Director.

REPORT OF DIVISION OF COMMUNICABLE DISEASES.

INTRODUCTION.

Comparatively few years ago the study of communicable disease outbreaks, the application of those sanitary measures which are grouped under the general term "sanitary engineering," and the tabulation of vital statistics comprised the entire field of official health administration.

Under the old-time conception of disease prevention nothing was done until disaster occurred. When the epidemic was upon the community most painstaking investigations were the rule.

The causes of epidemics were sought in all manner of conditions which we now know could not possibly have had any effect upon their occurrence. As a natural result, epidemics ran their courses until they died out for lack of further susceptible human material.

The occasional or sporadic occurrence of cases of communicable diseases were practically ignored so far as health authorities were concerned, except to place cumbersome and useless restrictions upon those who happened to be in contact with the sick or to elaborate far-fetched and fanciful explanations of the channels of infection. As has been well said by one of the foremost exponents of modern scientific epidemiology, "The old public health was concerned with the *environment*." It failed in its purpose of disease prevention. It failed because "it sought for the sources of infectious diseases in the air, the water, the earth, in climate and topography, in the rise and fall of ground waters, in fluctuations of soil temperature at 4 and 6 feet deep." In short, the old public health sought painstakingly and exhaustively to locate both the source and the routes of infection nearly everywhere except where they actually were.

The new science of communicable disease study and suppression seeks and *finds* these sources because it studies the individual rather than his surroundings. It looks to man himself or his associates in the animate world, especially animals and insects, as the source of infection instead of to the phenomena of the inanimate world. In a like manner the new science of communicable disease control finds the *channels* of infection by following the route of the discharges of excreta from the infected person to the new victim. In the vast

majority of instances modern epidemiology finds that infection is spread by the discharges of the mouth, nose, intestines or bladder. The only other great groups of infectious diseases, the insect-borne and the venereal, are essentially identical in their manner of transmission, since they are both direct wound infections. In the first instance by minute puncture wounds, in the second by minute abrasion wounds.

Hence, in spite of adding to the complexity of these problems by such things as chronic "carriers," or by the variation of immunity, modern preventive medicine believes implicitly in the practical truth of Pasteur's great dictum, "It is within the power of man to abolish infectious diseases from the world." Modern communicable disease workers go farther than this. They hold that we already know how to abolish the great majority of communicable diseases, and that failure to do so by the civilized world to-day is not only regrettable from a humanitarian standpoint but is a most extravagant waste of human machinery. Modern hygiene not only can demonstrate that the financial burden imposed by the continued prevalence of communicable diseases is an enormous tax on every community, but it has demonstrated that in the case of many communicable diseases the application of already well-proven principles of prevention soon produces a marked and speedy reduction in their prevalence.

To-day communicable diseases no longer play the all-important part in health work. Personal hygiene, the prevention of noninfectious diseases, infant, child, school, industrial, rural and social hygiene, as well as food sanitation, proper nutrition, and the like, all appear before the vision of hygienists as health-sustaining agencies of the greatest practical benefit. They all demand and receive a rapidly increasing share of the energy and funds of health departments. They all yield wonderful returns in terms of increased human happiness and efficiency. Yet for the present and for at least some decades to come, in the vast field of human health the problems of communicable diseases must remain the crude, great, immediate task alike of the health administrator, the educator, the healing professions and the general public.

To-day the science of communicable disease control is playing for big stakes. For the better control and suppression of various diseases it is boldly recommending programs that are both extensive and expensive. All the more essential, then, that it be right in the fundamentals. It is to be expected that errors of judgment in details will occur. Already the fundamental lines of procedure for the suppression of diphtheria or typhoid or malaria or tuberculosis have been clearly

established. All that remains is to persuade modern society that this task of communicable disease suppression is no chimera of crack-brained enthusiasts, but a sober, practical business proposition, and the end of many of our most serious communicable diseases is in sight.

In the pursuit of this end the doctrine of efficiency is as inexorable and unyielding in the sphere of health administration as in any other line of human activity. Public health administration has but one great ultimate standard of appraisal, — the death rate. If it lowers the death rate it is efficient. If it fails to lower it, it may or may not be inefficient, depending upon various circumstances, but the burden of proof of efficiency is always upon it. This means that in the field of communicable disease control there must be a more rigid application of the policy of adjusting the time of the workers and the expenses of administration in such a manner as will produce a maximum of results with a minimum of time, force and funds. This in turn means that up-to-date health administration must use all its methods and data simply as a means to an end. If proper progress is to be maintained it must as unhesitatingly “scrap” obsolete or inefficient methods to install in their place more efficient ones as a manufacturer must “scrap” his out-of-date machinery.

In arriving at a just estimate of the proportionate importance of communicable disease work to the entire field of public health, it is important to remember that its efficiency must not be judged by positive results alone. It has a certain negative duty that is only one degree less important than its great positive duty of reducing infections. This is to hold the gains already made. Too easy is it to-day to take all the achievements of disease prevention in the past as a matter of course; too easy to forget the price of toil and human suffering with which the present advances have been won. There is every reason for believing that, but for the barriers modern hygiene has erected in their path, pestilential diseases would sweep over the world to-day as never before, on account of the much greater facilities of rapid intercommunication between all parts of the earth than ever before existed.

Furthermore, the relative importance of communicable disease administrative and investigative work can never be correctly apprehended unless at least three factors are kept in mind, of which only the first usually receives consideration. These three factors are —

(a) The obvious. This means the immediate result of communicable disease prevalence in the mortality tables, or in the immediate burden placed upon the individual and society by the occurrence of communicable diseases from which the sufferer apparently recovers.

(b) The remote. By this is meant the very important but frequently overlooked connection between "recovered" cases of communicable diseases and other subsequent infections, or the development in later life of organic diseases commonly considered to be noninfectious in nature, but whose fundamental cause is an impairment of some part of the human machine by a previous and long-forgotten infectious disease. Recent studies indicate that as a result of infections in early life impairment of heart, blood vessels, kidneys or nervous system can be detected many years before these impairments finally manifest themselves, under the strain of middle age, as frank cases of heart disease or Bright's disease or some other constitutional malady.

(c) The concealed. By this is meant the effects of infectious diseases which are as yet not adequately recognized by the public or which for reasons of shame are carefully concealed by the victim, as, for example, the hidden effects of syphilis.

Another fact that must be given due consideration in arriving at a proper conception of the relative importance of communicable disease suppression is the manner in which communicable disease problems enter into every other sphere of health work. Such important fields of health administration as school hygiene, industrial hygiene or the sanitation of food supplies have already been enumerated. No small part of the problems of school hygiene and industrial hygiene is that of preventing tuberculous infections. The sanitation of food supplies owes all of its health importance to the possibility of foods acting as mechanical carriers of infectious diseases. This interrelation of communicable disease problems with all the other great divisions of public health might be easily extended to cover practically every specialized field in the entire realm of hygiene.

ESTABLISHMENT OF DIVISION.

The Division of Communicable Diseases of the Massachusetts State Department of Health was established by resolution of the Public Health Council on Dec. 29, 1914. Of necessity, some time elapsed before the final organization of the Division was completed. The present director was appointed by the Commissioner and Public Health Council on Jan. 19, 1915, and the appointment confirmed by the Governor and Executive Council on Jan. 27, 1915. He assumed the duties of the position on Feb. 20, 1915.

Eight District Health Officers were appointed, following a competitive examination, by the Commissioner and Council on March 2,

1915, and their appointments confirmed by the Governor and Executive Council on March 18, 1915. Immediately following the examination eight health districts were outlined and the boundaries fixed. The districts are designated as follows: —

- No. 1, Southeastern District.
- No. 2, Eastern District.
- No. 3, Northeastern District.
- No. 4, North Midland District.
- No. 5, South Midland District.
- No. 6, Wachusett District.
- No. 7, Connecticut Valley District.
- No. 8, Berkshire District.

The District Health Officers were assigned their respective districts, and took up the duties of their new positions on April 1, 1915. The original appointees qualifying for the position as District Health Officer, and their districts, were as follows: —

- Dr. Adam S. MacKnight, Fall River, Southeastern District.
- Dr. Frank L. Morse, Somerville, Eastern District.
- Dr. William H. Coon, Haverhill, Northeastern District.
- Dr. Charles E. Simpson, Lowell, North Midland District.
- Dr. William W. Walcott, Natick, South Midland District.
- Dr. Merrill E. Champion, Arlington, Wachusett District.
- Dr. John S. Hitchcock, Northampton, Connecticut Valley District.
- Dr. Lyman Asa Jones, North Adams, Berkshire District.

On April 15, 1915, Dr. Frank L. Morse resigned as a State District Health Officer, following a ruling by the Commissioner and Public Health Council to the effect that the State Department of Health could not consistently permit him to retain his position as city bacteriologist for the city of Somerville and at the same time carry out his duties as a State District Health Officer. The vacancy thus created was filled by the appointment of Dr. Lewis Fish of Fitchburg, and Dr. Merrill E. Champion was transferred from the Wachusett District to the Eastern District, Dr. Fish taking over the Wachusett District.

On Oct. 23, 1915, taking effect Nov. 30, 1915, Dr. William H. Coon resigned as a State District Health Officer to accept a more remunerative and otherwise attractive position as industrial sanitarian for the Fiske Rubber Company of Chicopee Falls. The vacancy created by his resignation has not yet been filled.

The personnel of the diagnostic laboratory at the time of the or-

ganization of the Division consisted of a bacteriologist and a stenographer and a media maker. This personnel remained unchanged, Miss Edith A. Beckler continuing in charge of the diagnostic laboratory under the director of the Division.

The rapid increase in the routine work demanded of the laboratory during the past year soon resulted in the number of specimens becoming entirely too great for a single bacteriologist to diagnose, even by working evenings, Sundays and holidays. Accordingly, on April 21 Miss Ruth Bryant, instructor in the department of biology at Simmons College, was engaged on a part-time basis to assist the bacteriologist. As the work steadily and continually increased, it soon became evident that a full-time assistant was an absolute necessity if the work of the laboratory was to be maintained. Accordingly, a permanent position of assistant bacteriologist was created which was filled by Miss Katherine Marden on Sept. 1, 1915. The same increase of work necessitated the addition of an assistant to the media maker on Oct. 19, 1915.

The general clerical force of the Division was organized by utilizing the services of the stenographers and clerks who had previously been doing the communicable disease work. It soon became evident that a competent statistician was an absolute necessity to the work of the Division, and a statistician was employed on Aug. 20, 1915.

On June 1, 1915, Dr. Walter H. Brown was appointed as epidemiologist to the Division. For administrative purposes the supervision of the routine reports of communicable diseases, their compilation, analysis and comparisons, has been placed under the epidemiologist, in addition to his services in the field.

SCOPE OF THE DIVISION'S WORK.

The Division of Communicable Diseases of the Massachusetts State Department of Health has for its province the study, investigation and supervision of all communicable diseases occurring in the State, whether the same are at present required to be reported by law or not. In addition, the Division of Communicable Diseases stands in a somewhat peculiar position in the organization of the Department because of the fact that the District Health Officers, who are the general field representatives of the Department, are, for administrative purposes, placed under the Division of Communicable Diseases. This involves a very close co-operation between the work of this Division and all of the other divisions of the Department. Therefore, a great deal of the work of the Division is not confined to communicable

diseases, so far as the duties of the director and the District Health Officers are concerned, but the activities of the subdivisions of epidemiology and the diagnostic laboratory are strictly confined to communicable diseases.

In an administrative sense the Division of Communicable Diseases recognizes no distinct subdivisions, but as a matter of fact the work falls so naturally and inevitably into three clear-cut lines that for the sake of convenience they will be referred to in the rest of the report as the subdivisions of —

- A. Epidemiology.
- B. The diagnostic laboratory.
- C. The District Health Officers.

A brief outline report of the work of each of these subdivisions is submitted at this point. Immediately following is a summary of the present communicable disease problems of the Commonwealth. For more detailed information on the work of each of the subdivisions the reader is referred to their respective individual reports.

A. THE SUBDIVISION OF EPIDEMIOLOGY.

THE WORK OF THE EPIDEMIOLOGIST.

The duties of the epidemiologist may be classified under two broad general heads, — office or statistical epidemiology and field or investigative epidemiology. Under his supervision careful study is made of the daily reports of communicable diseases received at the central office of the State Department of Health from local boards of health. Any unusual incidence of cases at all suggestive of beginning epidemics or outbreaks is immediately referred to the District Health Officer in whose district it occurs for investigation. Statistical studies upon the significance of the variations in communicable disease reports in the various localities of the State, and for the State as a whole, are carried out continuously. Detailed lists of the diseases required to be reported as dangerous to the public health, together with the deductions and studies made therefrom, will be found in the report of the Epidemiologist.

SYSTEM OF DISEASE REPORTING.

A very brief statement as to the nature of these reports is sufficient at this point. The method of reporting in the Commonwealth of Massachusetts is for the physician or householder to report individual

cases of diseases dangerous to the public health, upon a form specified by the local boards of health, to each local board of health. The local board of health reports the name, address, diagnosis of the disease, and date upon which reported to it, by a double postal card system, one of which is sent to the District Health Officer in whose jurisdiction the city or town is located, the other being sent direct to the office of the State Department of Health.

This method of communicable disease reporting has several distinct limitations and disadvantages. It is impossible to obtain any practical epidemiological clues from these reports without subsequent investigation. The reports as they come in may have case reports of several diseases on the one card, which necessitates a tedious amount of compilation and segregation in the central office in order to maintain any comprehensive grasp on the varying prevalence of any particular communicable disease in the State as a whole or in any given city or town. This system also makes it practically impossible to correlate the information obtained in the diagnostic laboratory with the routine disease reports.

This system of reporting has two distinct advantages: (a) It makes it quite easy for the local board of health to report both to the District Health Officer and to the central office of the State Department of Health, thereby rendering much less likely the possibility of a threatened outbreak being overlooked, as it serves as a threefold check, — knowledge of the local board of health, scrutiny of the State District Health Officer, and the tabulated analysis in the central office of the Department, which shows at a glance any suspicious grouping of any communicable disease in any locality on any day in the year. (b) Furthermore, the present disease reporting system is relatively inexpensive.

EPIDEMIOLOGICAL BOOKKEEPING OR MORBIDITY BALANCE SHEETS.

One of the most difficult and puzzling problems in the routine morbidity work of the Division has been to evolve some practical graphic methods which would enable the executive officers to tell at a glance the fluctuations of communicable disease prevalence. Numerous devices have been conceived, but they have proved in actual practice to require an unreasonable amount of time and labor. Thoroughly satisfactory methods have not yet been evolved, but after a tedious amount of experimentation it is believed that a simple, easily kept up and easily understood scheme of graphic representation of contagious disease prevalence has finally been worked out which will be put into effect during the coming year.

In the endeavor to get a continuous daily definite grasp upon the communicable disease situation throughout the Commonwealth, it was soon found that to do the work properly would involve a great deal of careful statistical work. The statistician employed is an expert mathematician, and has, under the supervision of the director and the epidemiologist, worked out some practical methods by which in the future it will be not only possible to keep up accurately with any current prevalence of disease, but also to keep a constant comparison of the significance of such occurrences with the average morbidity record of each community for several years past. This work which is just begun will involve a great deal of detailed statistical labor, but when completed should prove of the utmost practical importance for the work of the entire Department.

COMPILATION OF REPORTS.

Analogous to the development of the work of the statistician has been the improving, under the direction of the chief clerk of the Division, of the methods of routine compilation of the reports of communicable diseases as they come in. The statutes of this Commonwealth require compilations of communicable diseases to be made on a weekly basis. In several particulars, for practical morbidity work, daily, monthly and annual compilations give results that are superior to the system of weekly compilation. After a great deal of time and effort an ingenious system of compiling has been devised by which the communicable disease record of each city and town in the Commonwealth for each individual disease can be kept in such a manner that the weekly compilations can be taken off while at the same time the monthly totals are automatically recorded.

FOLLOW-UP SYSTEM.

For efficient communicable disease control follow-up systems are a necessity. Under the present laws of reporting and handling communicable diseases in this Commonwealth all detailed follow-up work in individual cases of disease must be handled by the local boards of health. Follow-up work for *epidemics* can be and is carried out by the State District Health Officers; but with the wide variations in the degrees of quarantine or isolation that are maintained for the same diseases by different cities and towns in the Commonwealth as to the length of time in which the same diseases are kept under restraint by the different cities and towns, and the manner in which such restrictions are removed, it is a practical impossibility for the

State Department of Health to do any follow-up work for individual cases of acute contagious diseases. Through the co-operation of the State Department of Health, the Trustees of Hospitals for Consumptives, the State Bureau of Vital Statistics, and the local boards of health throughout the Commonwealth a very comprehensive follow-up system has been evolved for all cases of tuberculosis. The details of this system will be found in the report of the epidemiologist. It is sufficient to state here that it gives promise of being a most effective weapon in the hands of the Department in the fight against tuberculosis.

LACK OF ADEQUATE MORTALITY REPORTS FOR CHECKING UP RESULTS.

Another feature which adds materially to the difficulties of communicable disease work in Massachusetts is the double system of mortality reports. Vital statistics are handled by the Bureau of Vital Statistics, which is a subdivision in the office of the Secretary of State. In addition to the reports to the Secretary of the Commonwealth, all city and town boards of health are by another statute required to report weekly to the State Department of Health all deaths from diseases that have been declared dangerous to the public health by the State Department of Health. Still a third statute requires that "the board of health in towns which have according to the latest census more than five thousand inhabitants shall send an annual report of the deaths in such town to the State board of health upon forms to be prescribed by said state board."

Under present conditions this last statutory requirement is inefficient, incomplete, does not represent the entire State, and simply tends to render an already confused situation more confused. The system of mortality returns to the Secretary of State's office under the Bureau of Vital Statistics of the State is in all probability as complete a system of returns of births and deaths, if not the most complete, of any State in the Union. In connection with morbidity work it has a very serious drawback in one respect. This is due to the fact that there is no provision in the present law which requires death returns to be forwarded sufficiently promptly to the Bureau of Vital Statistics to make them of any concurrent value in connection with communicable disease work. The State Bureau of Vital Statistics fully appreciates this fact, and has extended every possible courtesy and co-operated heartily both with this Division and other divisions of the State Department of Health in endeavoring to get authoritative data upon which to base conclusions and to issue statements relative to

disease prevalence and fatality. It is probable that by still further study in the matter, in the near future the present system of mortality returns can be made much more serviceable for communicable disease work.

DECENTRALIZED SYSTEM OF COMMUNICABLE DISEASE CONTROL.

Massachusetts epidemiological procedure labors under a rather severe handicap due to lack of uniformity of communicable disease control. The advantages of having matters of quarantine, isolation and exclusion from school for contagious diseases uniform throughout all parts of a State are so obvious as to require no comment. This procedure has been followed throughout the United States and Canada except in two of the New England States, — Massachusetts and Rhode Island, — and two southern States, — Alabama and North Carolina.

In Massachusetts the strong inherited sentiment for local control of all matters in which it was at all possible to apply the principle of local control has resulted in leaving all matters as to time, place and means of communicable disease control in the hands of each local board of health.

This has resulted in some anomalous and rather progress-retarding developments in regard to practical progress in communicable disease control. For example, in one section of the State, a conference of local board of health officials revealed the fact that seven distinct variations of procedure were in vogue within a radius of 25 miles relative to conditions of readmission to school following scarlet fever.

Such discrepancies as these not only tend to lessen public respect for health regulations generally, but inasmuch as among these divergent conditions the minimum possible time in which a child could return to school varied by fully three weeks, the inevitable result follows that either some children are deprived of school advantages for an unreasonable period of time, or else the susceptible children in another town are exposed to an unjustifiable danger of infection.

This decentralized system of quarantine and isolation also has the natural effect of rendering any *routine*-effective "follow-up" work on the part of the State epidemiological authorities next to impossible. With 353 cities and towns each having a legal right to impose sanitary restrictions at variance with those of other cities and towns, with many of them taking good care to exercise their legal powers, and with the rules and regulations of each board subject to change at their own discretion without the requirement of even reporting such

changes to the State Department of Health, centralized "follow-up" work becomes impossible.

Yet with all these obvious drawbacks no one can carefully and impartially study and compare the practical results of communicable disease control in Massachusetts with those of any other States having State-wide, uniform systems of communicable disease control without admitting that the average enforcement of regulations, and average prevention of spread of epidemic diseases, is as high in Massachusetts as anywhere in the United States. This highly creditable result is to be accounted for as having been achieved in spite of the system rather than because of it.

This Commonwealth has required the notification to health authorities by physicians and householders of all cases of diseases, declared dangerous to the public health, for a long time. In this it has had the intelligent and cheerful co-operation of the medical profession. The local health officials of the State, as a whole, are characterized by their strong common sense and their long-established custom of exchanging opinions and viewpoints through the medium of the Massachusetts Association of the Boards of Health. This combination has resulted in an actual line of procedure which has avoided that state of sanitary and epidemiological chaos that might easily result from the entrusting of quarantine and health regulations in general to 353 absolutely independent tribunals.

EXTENSION OF LIST OF REPORTABLE DISEASES.

On Dec. 15, 1914, by resolution of the Commissioner and Public Health Council, acting under the authority of chapter 75, sections 49, 50 and 52, and subsequent amendments, the State Department of Health declared the following diseases to be added to the list of diseases to be reported as dangerous to the public health:—

Dog bite (requiring antirabic treatment).

Dysentery:—

(a) Amœbic.

(b) Bacillary.

Hookworm disease.

Suppurative conjunctivitis.

Malaria.

Mumps.

Plague.

Septic sore throat.

This action was taken by way of ratification of an identical list promulgated by the Acting Commissioner of Health, Dr. W. C. Hanson, on Sept. 22, 1914, the legality of which was in doubt. The complete list of diseases which are now reportable by physicians and householders as dangerous to the public health is as follows: —

Actinomycosis.	Leprosy.
Anterior poliomyelitis.	Malaria.
Anthrax.	Measles.
Asiatic cholera.	Mumps.
Cerebrospinal meningitis.	Pellagra.
Chicken pox.	Plague.
Diphtheria.	Rabies.
Dog bite (requiring antirabic treatment).	Scarlet fever.
Dysentery: —	Septic sore throat.
(a) Amœbic.	Smallpox.
(b) Bacillary.	Tetanus.
German measles.	Trichinosis.
Glanders.	Tuberculosis (all forms).
Hookworm disease.	Typhoid fever.
Infectious diseases of the eye: —	Typhus fever.
(a) Ophthalmia neonatorum.	Whooping cough.
(b) Suppurative conjunctivitis.	Yellow fever.
(c) Trachoma.	

The natural result has been an increase in the total number of cases of diseases dangerous to the public health reported in the Commonwealth for the past year over previous years, but it does not indicate, in any sense, a greater total prevalence of such disease. In all probability there has been a considerable less prevalence of communicable diseases than ever before, as the corresponding death returns as a rule show consistent decreases.

EFFECT OF EXTENDING THIS TOTAL LIST OF DISEASES DEFINED AS DANGEROUS TO THE PUBLIC HEALTH TO COME WITHIN THE MEANING OF CHAPTER 380, ACTS OF 1909 (AMENDATORY TO CHAPTER 213, ACTS OF 1902).

Chapter 213 of the Acts of 1902 and subsequent amendments simply provide that in case of inability on the part of any individual or the head of a household to meet all the expenses incidental to those communicable diseases that have been declared by the State Department of Health to be dangerous to the public health, such expenses shall be paid by the city or town in which the individual has a settle-

ment, or by the Commonwealth if no such settlement exists, without such assistance in any sense pauperizing the recipient or the recipient's family. On Dec. 15, 1914, by resolution of the Commissioner and Public Health Council, the State Department of Health declared the entire present list of reportable diseases to come within the meaning of chapter 380, Acts of 1909.

Within a few months subsequent to this resolution of the Public Health Council, which was communicated to local boards of health by a circular of Dec. 22, 1914, numerous complaints began to be brought to the attention of the Division of Communicable Diseases by executive officers of various local boards of health. In brief, the point they raised was as follows: —

With the extension of the provisions of the law providing for non-pauperizing care of persons sick with communicable diseases to such an extent that the list of diseases for which this care had to be given by the local health authorities was identical with the whole list of diseases required to be reported, there was a distinct tendency on the part of certain classes of the population to seek public aid for diseases that either were trivial in character or were diseases of such a chronic nature that the practical effect tended to the perpetual support at the expense of the community, when no such action would be taken by these individuals and their families if they had been obliged to accept such relief from the overseers of the poor, as had hitherto been the case.

When it became evident that this sentiment among local boards of health was very widespread, and there was grave opportunity for abuse of this provision of the law which was intended to give relief to deserving citizens in serious cases of illness, a hearing on this point was given by the Commissioner and Public Health Council on Aug. 24, 1915, at which representatives of the following city boards of health appeared: —

Cambridge.
Fall River.
New Bedford.
Lynn.

Worcester.
Lowell.
Brockton.

Following this hearing the matter of removing certain diseases from the list of those diseases dangerous to the public health within the meaning of chapter 213 of the Acts of 1902, and its subsequent amendments, was taken under advisement by the Public Health Council.

On Dec. 14, 1915, the Commissioner and Public Health Council

declared the following list of diseases to come within the meaning of this act:—

Amœbic dysentery.	Leprosy.
Anterior poliomyelitis.	Measles.
Asiatic cholera.	Plague.
Cerebrospinal meningitis.	Rabies.
Diphtheria.	Scarlet fever.
Dog bite (requiring antirabic treatment.)	Smallpox.
Infectious diseases of the eye:—	Tuberculosis (pulmonary or laryngeal).
(a) Ophthalmia neonatorum.	Typhoid fever.
(b) Suppurative conjunctivitis.	Typhus fever.
(c) Trachoma.	Yellow fever.

EPIDEMIOLOGICAL SUMMARY SYSTEM.

It was early found that the system of epidemiological reports from the State District Health Officers were somewhat incomplete and unsatisfactory from an epidemiological standpoint. With eight individuals continually investigating outbreaks of diseases and reporting thereon in detail, the individual variations in order and manner in which different particulars in different reports are taken up naturally become so great as to render comparison and analysis of such investigations difficult unless some standardized form is adopted.

For this purpose a standard form, known as an epidemiological summary, has been adopted in the Division of Communicable Diseases. The details of this system will be discussed under the report of the epidemiologist, but the benefits of its introduction were apparent at once.

REPORTS TO THE UNITED STATES PUBLIC HEALTH SERVICE.

In common with most of the other States in the Union, the Division of Communicable Diseases of the Massachusetts State Department of Health reports monthly in summary form the prevalence of all communicable diseases to the Federal health authorities. The Federal Public Health Service has in the last few years devised a more prompt and a somewhat more detailed form of reporting by which the epidemiological authorities of the various States are appointed directly as agents of the United States Public Health Service under the title of "collaborating epidemiologists."

There are certain definite advantages from this system, especially

as pertains to the possibility of infectious diseases being brought into the State from other States, reports being made promptly under this system by telegraph. Negotiations are now under way, but final arrangements have not been completed, to place the Commonwealth of Massachusetts among the list of States which act in this direct relationship with the Federal health authorities.

NEW FORM OF LOCAL RECORD BOOK FOR CONTAGIOUS DISEASES.

Section 51 of the Revised Laws, as amended by chapter 52 of the General Acts of 1915, provides that "the local board of health of each city and town shall keep a permanent record in such manner or upon such forms as may be prescribed by the state department of health, which shall contain the name and the location of all persons who are sick (with a disease dangerous to the public health), the name of the disease, the name of the person reporting, and the date of the report, and such other data as may be required by the state department of health."

Acting under the provisions of this statute the Division of Communicable Diseases this year drew up a uniform record book for the keeping of records of contagious diseases by cities and towns. This book is very much superior to the old type of book that has been used for many years, as it provides an opportunity in a compact form for keeping many of the details, both relative to epidemiological features of each case and such legal features as "settlement" and "reporting to the school authorities," etc.

When the form for this report was finally adopted, each local board of health was officially notified of the new form and directed to comply therewith. The statute did not make it the duty of any State department to furnish this record book. This failure to make any provision or appropriation for the placing of such a form of record book in the hands of the local authorities at first presented a serious obstacle because of the prohibitive expense of having such a book prepared for each individual local board of health. This obstacle was summounted by a stationery house in Boston, which does a large business with cities and towns throughout the Commonwealth, offering to get up this standard contagious disease record book at a very reasonable cost if the Division would notify all local boards of health that such books could be obtained from it. As this procedure was much more economical than for each board of health to have an individual book printed, the local boards of health throughout the State have gladly taken advantage of this arrangement.

THE NEED OF MORE UNIFORM TERMS IN COMMUNICABLE DISEASE WORK.

One of the difficult features of public health work in the United States is the utter lack of any uniformity of terms used in dealing with epidemics of communicable diseases in different States or even between various health bodies in the same State. What will be classified as an epidemic by one investigator will be called only a small outbreak by another. There is as yet no reliable record in any State of the average sporadic incidence for each city and town in the State of the various communicable diseases, yet such a record in addition to a record of the total prevalence for the State is very essential for intelligent communicable disease work. It is clear that before the most efficient work can be done in preventing epidemics it is necessary to know when an epidemic is beginning. In a rough manner, this point could be determined by any department which receives relatively complete daily reports by tabulating the total average of each individual epidemic disease for the various localities in the State over a term of years, and then promptly investigating every increase over this average as being in itself suspiciously indicative of an epidemic.

This Division is now working on such a scheme, the details of which can be found in the report of the epidemiologist. While it is as yet not completely worked out as to details, the great practical value of such a procedure is already apparent.

THE NEED OF DETERMINING THE RELATIVE EFFICIENCY OF THE VARIOUS PROCEDURES IN THE FIELD OF COMMUNICABLE DISEASES.

An important need in the field of communicable disease work is a more intelligent or accurate determination as to the practical value of the various procedures that are employed in the field of epidemiology. It is now universally conceded that many procedures have been carried out in the past for the purpose of disease prevention which were both irksome and expensive to an extreme degree, without in the slightest affecting the prevalence of the disease. The enormous amount of time, money and energy used in attempts to control yellow fever by shotgun quarantine and broadcast disinfection and fumigation before the discovery that the mosquito alone transmitted the disease is an excellent example of the case in point. To a lesser degree public health administrators everywhere are to-day probably

repeating the same type of mistakes in the routine handling of some of the common contagious diseases.

One of the greatest needs in epidemiological work is to more accurately determine what procedures are efficient in the control of communicable diseases in contrast with those that are merely meddlesome. As fast as these points are determined communicable disease control methods should be adjusted. It is the belief of practically all sanitarians to-day that when this adjustment is complete our common communicable diseases will be much more effectively controlled than at present, with very much less interference with the normal life of the individual citizen and his family.

B. DIAGNOSTIC LABORATORY.

INCREASE IN WORK.

The striking feature of the work of the diagnostic laboratory for 1915 has been the phenomenal increase in the amount of work done, and the fact that still greater demands were made upon the laboratory for service than its limited appropriation funds and equipment could supply. The increase in the work of the laboratory amounts in all to 147 per cent. since 1910, and to over 60 per cent. since 1913. The following table, showing the total number of specimens examined per annum for the past five years, demonstrates this fact more clearly than any description possibly could.

YEAR.	Number of Specimens examined.
1910, ...	6,458
1911, ...	7,814
1912, ...	7,854
1913, ...	10,701
1914, ...	11,924
1915, ...	17,229

DIFFICULTIES OF SERVICE.

This showing of amount of work done is all the more noteworthy when the difficulties surrounding the service are considered. The present quarters of the diagnostic laboratory are inadequate even to the point of being an actual menace to the health of the laboratory

workers. There is insufficient light, ventilation, space and equipment. It is impossible to do more work in the present quarters, although the force now available could handle more, on account of lack of room to make media, to incubate cultures, to examine specimens, to store cultures waiting for examination, and even lack of bench room to place microscopes. Any type of work would be of necessity handicapped in such inadequate quarters as the diagnostic laboratory now has, and it is a well-recognized fact that for laboratory work several times as much floor space and wall space is necessary than for general clerical work.

COST OF EXAMINATIONS.

One of the most important points about diagnostic laboratory work, from the standpoint of efficient public health administration, is the relative cost of examination per specimen. The cost per specimen for examination in the diagnostic laboratory has been for the past few years as follows:—

In 1913, 35 cents per specimen.

In 1914, 37 cents per specimen.

In 1915, 31 cents per specimen.

It is not possible to give accurate figures as to cost prior to 1913 because before that year the expenses of the laboratory were taken out of the general fund of the Board and no segregation was made. The only possible way this point could now be determined would be to analyze every individual voucher issued under the general appropriation of the Board since the laboratory was started, and to segregate the laboratory items. However, it is known that approximately the amount of money expended on the laboratory service since 1910 has been not far from \$4,000. On this basis the cost of examination per specimen has steadily declined, inasmuch as the total amount of output has increased 147 per cent., and the total amount of money available has increased only 40 per cent. since 1913, and it is quite certain that the expenditures for 1913 were little more than for the three preceding years.

This decrease in cost per specimen has been maintained in spite of three factors which might have operated to increase the cost per specimen without such increase being in any sense indicative of less economical administration. These three factors are, first, a very pronounced increase in the cost of laboratory supplies, especially glassware. This increase in cost is in large part due to the European

war. The second factor of increased cost really represents only departmental bookkeeping, but is in the aggregate a considerable item. It has come about because for this year (1915) for the first time the cost of printing for the laboratory has been charged to the laboratory fund, instead of leaving it unsegregated in the general printing account. The third increase in cost has been the necessity of adding an assistant bacteriologist and an assistant media maker.

Credit for having maintained the cost per specimen at a lower point than ever before is due almost entirely to the executive efficiency of the bacteriologist. While it is difficult to make absolutely accurate comparison with diagnostic laboratories of different State boards and departments of health, it is believed that at the present time this State is putting out highest grade laboratory service for physicians and local boards of health at a lower cost per specimen than the diagnostic laboratory of any other State.

RAPIDITY OF SERVICE.

One of the greatest problems of the laboratory is that of increasing the rapidity of service for routine work. This point becomes really of importance in terms of human life only in the case of diphtheria. In the two other diseases that furnish the bulk of routine laboratory examinations, — tuberculosis and typhoid fever, — no such need for very prompt laboratory returns exists. The bacteriologist has made the question of promptitude of returns one of the primary objects in the routine work of the laboratory. As a result of carefully systematizing methods of procedure the laboratory now sends out a report on 85 per cent. of the positive diphtheria specimens on the same day that they are received. This is a rapidity of service that is scarcely exceeded by any local diagnostic laboratory.

Nevertheless, strange as it may seem, there appears to be a strong impression among many physicians of the State that reports from the State diagnostic laboratory are very slow. If there is any real basis for this contention it must lie in three directions: first, in the time lost in transmitting specimens to the laboratory; second, in the time consumed when the specimens are in the possession of the laboratory before report is ready; and third, in the time lost in transmitting the reply to the physician or board of health sending the specimen. As above indicated, it is believed that the time actually consumed in the laboratory processes has been cut to the irreducible minimum. The one factor that tends to delay is the closing of the State House at noon on Saturday. However, specimens coming by *mail* can be de-

livered to the watchman. The bacteriologist or assistant bacteriologist always returns Saturday afternoon to cover late-coming specimens for the day, and invariably spends several hours each Sunday and holiday in getting out returns for those days. This extra overtime is given gratuitously by the bacteriologists. No extra compensation is allowed.

There apparently have been some well-grounded complaints of unreasonable slowness in delivery on the part of the mails. A careful study will be made of this side of the question during the coming year. The greatest cause of all for delay is failure to provide for telegraphic or telephonic return reports in the case of diphtheria specimens by the physicians or local board of health sending the same. This should be done in all instances where the culture is sent for diagnostic purposes. Train service is so complete and so rapid from all parts of the Commonwealth to the city of Boston that apparently few hours need be consumed in transmitting specimens from most points in the State, provided the sender uses proper diligence to make sure that the specimen leaves the local post office promptly.

LABORATORY WORK OF A RESEARCH NATURE.

In addition to the routine examination of specimens submitted for diagnosis the laboratory is doing an increasing amount of most valuable epidemiological research work. This work is as yet only very imperfectly developed, and is susceptible of great advances in the future, which should have as a natural result a diminution of the prevalence of certain communicable diseases, especially diphtheria and typhoid fever.

This work may be grouped under three general headings: first, the search for typhoid carriers; second, the search for diphtheria carriers, which is principally carried out by means of routine school cultures in instances where diphtheria continues persistently; and third, in the carrying out of the virulence test in cases of unusual persistence of diphtheria bacilli in the throat.

(a) *Search for Typhoid Carriers.*

The search for individual typhoid carriers becomes of paramount importance in certain continuing outbreaks or epidemics of typhoid fever. In fact, it is oftentimes the only possible way in which the true source of the disease can be ascertained and the outbreak stopped. The method, in brief, is to first determine by careful epidemiological examination the total number of persons who have been handlers of

milk or other food products, and consider them all under suspicion until proven otherwise; then to take blood specimens for the Widal test from all of them, and then to follow up all positive Widal returns by obtaining specimens of the urine and feces and examining repeatedly for the typhoid germ. In some instances where the Widal is negative the epidemiological evidence will be so direct as to make it advisable to go through the search for the organism in the excreta, and not infrequently the carrier is located by this means.

But all of this work is extremely tedious and time-consuming. To isolate a single organism such as the typhoid bacillus from a specimen of feces, which is always teeming with countless millions of bacteria of almost infinite variety, is in itself no small piece of work. In carrying out this type of work during the past year 382 cultures, representing 260 individuals, were examined, and in all the typhoid bacillus isolated in 23 instances.

(b) *Diphtheria Carrier Work.*

The details of examination for detecting the diphtheria carriers will be found under the report of the epidemiologist. At this point it is only necessary to indicate that the problem is quite different from that of the search for typhoid carriers, because of the much larger number of individuals that have to be considered. Fortunately, the work on the individual case is very much less than that in the search for typhoid carriers. This type of work has been carried out in many instances during the past year, but has not yet begun to be utilized as generally as it should. However, to obtain results at all commensurate with the amount of work involved, it is necessary that routine diphtheria culture work be done under a well thought-out previous plan.

Fundamentally, all such work as this is not of an emergency nature and cannot be allowed to usurp the demands upon the laboratory for immediate diagnosis. This fact, together with the fact that the total output of the laboratory is distinctly limited, renders the extension of routine search for diphtheria carriers a slower process than would otherwise be the case. In many instances the local school and health authorities seem unable to comprehend the limitations and difficulties of this type of work; but as it is gradually expanded, a clear understanding of both its usefulness and its limitations is being reached by both the laboratory authorities and the local health authorities. It is believed that the ultimate result will be of very marked assistance in diminishing the prevalence of diphtheria.

(c) Diphtheria Virulence Test.

The virulence test for diphtheria deserves a brief special notice. In a certain proportion of the chronic diphtheria carriers the type of germ is not in the least capable of producing disease. Therefore, in order to avoid injustice in matters of quarantine, it becomes highly essential that this point should be determined in all doubtful cases. This is done as routine on all positive results in searching for diphtheria carriers, and done upon request of the local authorities whenever a person who has had the disease has been quarantined for an unusual length of time and still shows a positive result on "release" culture. This test is not a complicated or difficult one after the diphtheria bacilli from the throat of the individual under suspicion have been obtained in culture entirely free from the other contaminating germs that always occur with the diphtheria bacillus in the throat. However, this procedure in itself is extremely tedious and time-consuming.

LABORATORY RELATIONS WITH LOCAL DIAGNOSTIC LABORATORIES.

One of the most far-reaching problems before the Division of Communicable Diseases is the question of most efficient development of laboratory service for many of our common infectious diseases whose more and more complete suppression involves to an increasing degree the early, prompt and repeated utilization of laboratory facilities. For very large cities there can be no question that the most economical as well as the most efficient method of solving this problem is that of maintaining their own diagnostic laboratories under the control of the local boards of health.

For the smaller cities and towns there are three possible solutions of this problem: —

(a) To greatly increase the facilities and output of the State laboratory and at the same time decrease in all possible manner the delay incident to transmission of specimens and of return reports. In brief, to encourage greater utilization of the State diagnostic laboratory rather than the further establishment of the development of small local laboratories.

(b) The second solution of the laboratory problem is to encourage the establishment of a large number of strictly local laboratories.

(c) The third system is one that has been adopted very successfully in certain States, all of which have much larger areas than Massachusetts. This policy is one by which the State continues to finance and supervise the diagnostic laboratory service to physicians and boards of health in precisely the same way as through the central laboratory, but at the same time it endeavors to approximate the advantages of local laboratory service. This is brought about by the establishment of so-called State branch diagnostic laboratories.

The director of the Division and the Bacteriologist have made some studies upon this problem, but do not feel that the best policy can yet be determined. One thing is certain, — there can be no advantages in the shape of local promptitude of service sufficient to offset some very distinct disadvantages in maintaining a separate laboratory service for aggregations of population of less than 50,000. If a considerable amount of water and milk routine laboratory work is carried on in connection with the diagnostic laboratory work there is ample room and need for a well-equipped laboratory in any community of over 50,000. If the only laboratory service that is furnished is that of diagnosis of clinical specimens, and reasonably prompt service can be obtained from a larger, more completely equipped laboratory, it is very questionable whether the advantages of local service are sufficient to offset the disadvantages in cities between 50,000 and 100,000. In cities of 100,000 and over the advantages of maintaining a local laboratory greatly outweigh any possible disadvantages. The greatest disadvantage in maintaining a separate laboratory in a small town is the excessively high cost per specimen. In the aggregate, this becomes out of all proportion to the benefits derived.

To illustrate what is meant by this it is necessary only to cite one comparatively small town which could, if it chose, have a prompt service without cost from the diagnostic laboratory of the State Health Department, and which is now paying approximately \$2 per specimen for examinations at a laboratory which is not as convenient of access as the State laboratory.

The distance alone is not the determining factor in the utilization of the State laboratory. This fact is very easily demonstrated by dividing the State on a basis of zones and determining the number of specimens submitted in proportion to the population, exclusive of those cities and towns maintaining their own bacteriological laboratories or contracting to receive full bacteriological laboratory service from neighboring cities and towns. This has been done and the result computed for a five-year period, — 1910-15, inclusive. The table shows variations in the amount of laboratory service furnished by the diagnostic laboratory of the State Health Department, according to average distance from the State House.

ZONE (MILES).	Population, ¹ 1910 Census.	Yearly Average Specimens examined for Five-year Period.	Yearly Average Specimens examined per 1,000 Population.
0- 15, ...	374,598	3,995.0	8.5
15- 30, ...	378,777	2,153.6	5.3
30- 45, ...	178,198	641.4	3.4
45- 60, ...	123,097	516.4	4.1
60- 75, ...	51,732	696.8	12.6
75- 90, ...	68,843	110.4	1.3
90-105, ...	31,408	75.0	2.0
105-120, ...	58,980	172.4	2.9

¹ Exclusive of the population of cities and towns maintaining their own diagnostic laboratory service.

This table demonstrates some interesting facts. It shows, in the first place, that both in the gross and the proportionate number of specimens examined there is a sharp contrast between that portion of the State which lies beyond the 90-mile zone, which is approximately the section west of the Connecticut River, and that portion of the State that lies to the east of the Connecticut River. For if all the State east of the Connecticut River is considered as one group, we find that its average utilization of the service of the diagnostic laboratory would be 7.2 specimens per year for every thousand population; whereas that portion of the State that lies west of the Connecticut River utilizes the laboratory services only to the extent of 2.2 specimens per year for every thousand population. This, however, means either a very marked discrepancy in the prevalence of the diseases in which laboratory examinations are of service for the extreme western portion of the State compared to the rest of the State, or failure on the part of the physicians and local boards of health from that portion of the State to utilize modern laboratory assistance to a very great degree. It is probable that both factors enter into the problem somewhat, but it is hard to avoid the conclusion that the greatest reason why laboratory assistance is not more utilized is on account of the distance and time consumed in specimens reaching the laboratory. This suggests very strongly a possibility that the best ultimate solution of the problem of furnishing laboratory service for the western portion of the State may be the establishment of a branch diagnostic laboratory at a point that is most readily accessible to all localities of that portion of the State. This center would logically be Springfield.

THE CORRELATION OF LABORATORY WORK WITH EPIDEMIOLOGICAL WORK.

Strictly speaking, a diagnostic laboratory is only a means to an end. It is not to be regarded as a complete entity in itself, but simply as an extension of the work of the physician at the bedside, and of the health authorities and of the epidemiologist in controlling communicable diseases. It has its reason for existence as a public health agency only in so far and to such an extent as the laboratory serves as a means of interpreting puzzling results obtained in the field, or in settling doubtful points in the physician's diagnosis. Reduced to the briefest possible terms, this means that the most efficient routine diagnostic laboratory is the one whose routine methods of work are fixed and determined by the epidemiological needs of the community or communities which it seeks to serve; or, in other words, that the work of the diagnostic laboratory should be subordinate to the broader task of the suppression and control of communicable diseases in general.

The diagnostic laboratory of the State Department of Health, as at present organized, is endeavoring to carry out this policy exactly. One of the ways in which the laboratory can give this service most efficiently is by serving as a close check upon the completeness, promptness and accuracy of the reports of communicable diseases. To carry this out involves a rather careful, detailed system of filing and continual follow-up work. At the present time, for reasons outlined under the consideration of the work of the epidemiologist, this cannot be done in this Commonwealth to any pronounced degree of efficiency. Nevertheless, by adopting the system of sending out to the State District Health Officers and to the local boards of health duplicate copies of the positive diagnoses of typhoid fever, diphtheria and tuberculosis, the laboratory proves to be a most efficient means of getting prompt and early account of communicable disease situations which otherwise might prove much more extensive through the thoughtlessness or delinquency on the part of the physician in failing to report the same promptly to the local authorities.

THE DISTRIBUTION OF SILVER NITRATE PROPHYLACTIC FOR THE PREVENTION OF OPHTHALMIA NEONATORUM.

This feature of the work of the Division of Communicable Diseases does not come under the laboratory, but for convenience of administration the distributing service, by which antitoxin and vaccine are

sent out, and mailing cases for bacteriological specimens, is also used for the distribution of this prophylactic. Under the report of the State District Health Officers will be found a more detailed discussion, accompanied by a chart, of the really quite remarkable showing in decreased prevalence of serious cases of ophthalmia neonatorum in the Commonwealth in the years since the policy of distributing prophylactic was adopted plus the policy of careful individual investigation of all reported cases by the District Health Officers. However, shortly after the director of the Division assumed the duties of his position, complaints began to be called to his notice relative to the form of silver nitrate prophylactic that the State has been distributing for the past few years. These complaints, which came mostly from the individual physicians, some from the local boards of health, related almost entirely to the occurrence of small particles floating in the solution. Several of the District Health Officers also expressed an opinion that the occurrence of these small particles at times caused a transient irritation in the eyes of the infant which had been treated with the prophylactic.

The matter was referred to the laboratory of the Division of Food and Drugs for investigation and analysis. The director of that Division reported that the particles were unquestionably small disintegrated bits of rubber from the dropper itself, which had been caused by the action of the silver nitrate upon the rubber. He also reported that analysis of the first specimens all indicated that the silver nitrate strength was far below the 1 per cent. standard that was recommended and stamped upon the dropper. As a result of this examination the food and drug laboratory was asked to make examination of many specimens, including some droppers that had been returned as unsatisfactory by physicians and local boards, and some that had never been distributed. The analytical results showed that the solution was invariably far below the 1 per cent. strength required. Feeling that this state of affairs was of most serious import to the public health, inasmuch as reliance upon a product because of its being guaranteed by the State might conceivably be a direct cause of the total loss of vision, in spite of the remarkably favorable showing that had taken place in the decrease of ophthalmia neonatorum since the institution of free distribution of the prophylactic, a careful investigation was made as to the reliability of various outfits on the market containing silver nitrate prophylactic. One was finally found, guaranteed by a most reliable biological house to be under all conditions within the terms guaranteed, very close to 1 per cent. strength. This product costs considerably more than the old product, but as the latter had proved

to be so utterly unreliable, the change was made and the new type of prophylactic is now in stock and will be distributed at once to the medical profession and local boards of health.

Statistical details of the work of the diagnostic laboratory can be found under the report of the bacteriologist.

C. THE WORK OF THE STATE DISTRICT HEALTH OFFICERS.

INTRODUCTION.

Most vital and most representative of all the activities of the Division of Communicable Diseases is the organization of the State District Health Officers. Without their constant watchfulness and prompt conference with local health authorities much, perhaps the major portion, of the epidemiologist's work in systematizing and studying the returns of communicable diseases would be practically wasted, so far as immediate disease-preventive work is concerned. And in modern public health work it is the aborting of epidemics that counts rather than holding "post mortems" on them after they have had their run untrammelled only to die out eventually for lack of fresh material.

Without the District Health Officers constantly available to point out the possibilities and the limitations of the laboratory service, much of the trained skill of the diagnostic laboratory personnel would go unutilized.

Without their continual friendly supervision the work of the various tuberculosis dispensaries would lack greatly in efficiency, and would present no uniformity of plan or procedure.

Without their constant watchful advice many local boards of health would waste valuable energy and enthusiasm on faddist health movements which experience has shown to be of little or no lasting value.

Without ever-present moral pressure from the District Health Officers many of the local boards of health in smaller towns would tend to lapse into a continuous state of catalepsy, greatly to the detriment of the public welfare.

ORGANIZATION.

The act creating the State Department of Health provides for the establishment of eight health districts, each under the supervision of a full-time District Health Officer who shall be the direct personal representative of the Commissioner of Health, and, under the directors of divisions, shall secure the enforcement within each district of the public health laws and regulations. The law provides that a District

Health Officer must be a graduate of a recognized school of medicine or have at least five years' experience in public health duties and sanitary science. It further provides that each District Health Officer shall have all the powers and perform the duties previously performed by the State Inspectors of Health. The District Health Officers shall be appointed and removed only with the approval of the Public Health Council. No details are given as to the manner of either appointment or removal. It is further provided that the compensation, not in any case exceeding \$3,500, shall be approved for each appointment by the Governor and Executive Council.

By resolution of the Commissioner and Public Health Council it was decided to fill the eight positions by a competitive examination open to all eligible candidates; and a set of rules and regulations governing the appointment and promotion, and stating that preference would be given to citizens of Massachusetts and that public health administrative experience would be duly allowed in the final relative standing, was promulgated by the Commissioner, approved by the Public Health Council, and sent to all persons who made applications or inquiries regarding the position of District Health Officer. With this a form of voucher was sent out to be signed and returned with a formal application by the person desiring to take the examination before any were considered eligible. The date of the examination was announced both by the public press and by individual notices to applicants.

The Commissioner of Health appointed a board of examiners, consisting of the director of the Division of Communicable Diseases, as recorder, and four members of the Public Health Council. Written examinations were held in the following subjects: —

- (a) Preventive medicine.
- (b) Communicable diseases.
- (c) Hygiene and sanitation.
- (d) Pathology, bacteriology and vital statistics.

In addition, an oral examination was held, and each candidate was required to show evidence of physical fitness to perform the duties of the office. Through the courtesy of the Civil Service Commission their regular examination room was used, and one of the officials of the Civil Service Commission, following their usual procedure, assigned a number to each candidate, and received, under seal, the name corresponding to the examination number. These names were kept by the Civil Service Commission until the examination papers had been corrected and the final ratings made in accordance with the

examination number. In this manner the board of examiners had no knowledge of the identity of the authors of the various sets of papers. In all, approximately 50 candidates made inquiry. Of these, all but 27 were not eligible to take the examination, some because of the age limit, and others because of unwillingness to accept the full-time principle. In fact, a great deal of controversy and opposition was aroused over the insistence by the Commissioner of the full-time principle, — a rather remarkable occurrence in the face of the plain, explicit language of the statute, which says, "They shall not engage in any other occupation and shall give their entire time to the performance of their duties."

Twenty-seven candidates were admitted to the examination. One of these was subsequently disqualified because of being over the age limit, and three were disqualified for final rating because of failure to complete the written examination, leaving a total of twenty-three who received final markings. Ten of the eleven former State Inspectors of Health qualified for the examination. As a group, their previous experience and thorough familiarity with public health work placed them far in advance of the inexperienced candidates. Seven out of the eight successful candidates were previously State Inspectors of Health. The eighth successful candidate was a physician who had not only an extensive experience as a local health officer in the Commonwealth, but also held a certificate in public health, and had spent considerable time in rural sanitary work in another part of the country prior to taking the examination.

Following the appointment of District Health Officers, conferences were held between the District Health Officers, directors of divisions and the State Commissioner of Health to determine the limits of each district and to outline the duties of a State District Health Officer. These preliminary conferences proved of such great advantage in arriving at a clearer reciprocal understanding as to the nature of their work, between the District Health Officers in the field and the Commissioner and directors of the divisions at the central office of the State Department of Health, that they have been continued since on a regular monthly basis.

It would be impossible to overestimate the importance of these monthly conferences. By this means, the field work has been planned out in advance and kept in correlation with all of the needs of the Department. New lines of work, especially those that involve the duties of the District Health Officers as representatives of other divisions of the Department than that of Communicable Diseases, have been determined, and the amount of time and expenditure to

be allotted to them also settled by direct conference between the various division heads and the District Health Officers. The work of the various District Health Officers has been, to no small degree, uniformly standardized by means of these conferences.

DUAL NATURE OF DUTIES OF DISTRICT HEALTH OFFICERS.

A clear comprehension of the activities, duties and results of the work of the District Health Officers of this Department cannot be obtained unless the point is thoroughly kept in mind that in Massachusetts the functions of the State District Health Officers divide naturally into two quite distinct sets of duties. It is a rather interesting fact that in actual practice during the past year there has been approximately an even division of the time of the District Health Officers in each of these fields of activity.

1. The first fundamental duty of the State District Health Officer is to act as the representative of the Department in the field for the suppression of communicable diseases. It is for this reason that, although acting as general representatives of the Department in the field, the District Health Officers in the administrative organization are placed under the Division of Communicable Diseases. The particular manner in which the activities of the District Health Officers are exercised in the field of communicable diseases can be found more in detail in the report of the District Health Officers themselves. It is perhaps sufficient to say here that during the past year their duties in this respect have been more or less evenly divided into two major divisions: (*a*) those pertaining to the extension of the antituberculosis program of the State, and (*b*) in the investigation of epidemics, outbreaks or individual cases of other diseases dangerous to the public health.

2. The other fundamental function of the District Health Officers is that of general representatives of the Department in their respective districts. This involves a multiplicity of duties that bring them in touch with the work of each one of the divisions of the State Department of Health.

Perhaps the greatest amount of time and energy that is devoted to this portion of their work consists in meeting in frequent and informal conferences with the local health authorities at their request. Another, though not so important a function, is that of looking up data and taking samples for the Engineering Division. Another is that of investigating, upon request of the director, matters that pertain to the Division of Food and Drugs. The greatest call for

the services of the District Health Officers from within the Department itself, however, aside from strictly communicable disease work, is along the lines of activity that are being developed by the Division of Hygiene. These include general public health educational work by lectures and otherwise, investigations into infant mortality and infant welfare, the extension of public health nursing, studies in rural hygiene, school hygiene, etc. In addition, each District Health Officer is from time to time detailed to special lines of work of an investigative nature that may be taken up by the Department.

Very briefly, the outstanding features of the work of the District Health Officers will be referred to at this point. Any who are interested in learning details are referred to the report of the District Health Officers.

(1) *Investigation of Communicable Diseases.*

The duties of the State District Health Officers in this respect are as follows: —

(a) *Routine Disease Reports.* — They receive simultaneously with the central office of the Department daily reports from local boards of health of the communicable diseases reported by the physicians and householders. Each District Health Officer keeps a rough working scheme by which he can detect at once unusual prevalence of any of the epidemic diseases in any community. Whenever the grouping of reported cases suggests the possibility of becoming epidemic he at once gets in touch with the local authorities of the city or town under suspicion, and thereafter carries out such epidemiological researches as may be indicated, limited only by the desire of the local authorities for assistance and the amount of time that he can devote to such work. When any individual epidemic, either from the standpoint of number of cases or from obscurity of origin, reaches a point where it requires the undivided attention of the investigator for some time, or if the District Health Officer is unable to satisfactorily reach any explanation of the causation of the epidemic, he then calls upon the epidemiologist of the Department to assist him.

(b) *Tuberculosis Follow-up Work.* — In addition to this close personal scrutiny of distinct disease outbreaks, it has been the general policy of the Department to develop certain distinctive lines of work for individual diseases which do not occur in epidemic form, but which are of particular interest. The chief of these is tuberculosis. The details of the follow-up system for tuberculosis can be found in

the report of the epidemiologist. In brief, it may be said that the present system of tuberculosis control involves the co-operation of several factors, the principal ones being the practicing physicians, the local boards of health, the tuberculosis dispensaries in the larger cities and towns, the public health nurses engaged exclusively or partially in tuberculosis visiting and instructive work, the local tuberculosis hospitals, the Trustees of Hospitals for Consumptives and the State Department of Health.

The State District Health Officer plays a most important part in this follow-up scheme; in fact, he may be justly designated as the connecting link between all other factors. The establishment, personnel, methods of procedure and approval or disapproval as to results, in the case of the tuberculosis dispensaries, are under his direct supervision. The follow-up system for the individual consumptive is based upon reciprocal reporting between the officials in charge of the tuberculosis sanatoria, the local boards of health and the tuberculosis dispensaries. In those cities and towns maintaining a tuberculosis dispensary the District Health Officer does not investigate any individual case unless it be one of special interest as an incorrigible case, for example; but he looks to the dispensary physician and nurse and the local board of health to keep the State Department informed as to the whereabouts and prognosis and death of the known consumptives, and to continually use all means in their power to discover, locate and get in personal touch with new cases.

In the towns not maintaining tuberculosis dispensaries, some two or three years ago the State Inspectors of Health started a policy of visiting and investigating end results in every reported case. This has proved in actual practice to be too great a task to be carried out completely, but as far as it can be possibly done the District Health Officers do follow up these cases. The link that is still missing here is a field tuberculosis or public health nurse, working under the direction of the District Health Officers, to do this service which is strictly analogous to the service already performed by the tuberculosis dispensary nurses in the larger cities and towns.

(c) *Follow-up Work in Ophthalmia Neonatorum.*—The District Health Officers follow up and investigate, either in person or through the agency of the local boards of health in the larger cities, every case reported as ophthalmia neonatorum. The results of this policy have been most gratifying. The reduction in the number of cases of blindness from this disease has been steady and constant from year to year, ever since the policy was inaugurated, until now it is very near the vanishing point.

(d) *Anterior Poliomyelitis Follow-up Work.* — A special investigation is made, as a routine, of all anterior poliomyelitis cases. As is the case with tuberculosis, the pressure of other work has prevented this being carried out in detail this year.

(e) *Diphtheria Investigation.* — The unreasonably high mortality from diphtheria that still prevails in the Commonwealth has led the District Health Officers on their own initiative to suggest, and, with the approval of the director and Commissioner, to carry out within the past few months an intensive investigation of all deaths from diphtheria reported in the Commonwealth during the past two years. This work will need to be carried out for fully a year before complete data will be available, but once this is done it is believed that the source of failure to save diphtheria cases will have been closely scrutinized, and remedial measures will then be inaugurated which ought very materially to reduce the death rate from this disease.

(2) *General Administrative or Investigative Duties.*

(a) *Organization of Local Health Workers.* — Experience has proved that in no field of public health endeavor are there more immediate and gratifying results than by better organizing already existing forces. With this in view, one of the chief functions of the District Health Officer is to actively foster and inaugurate organizations of boards of health and of public health nurses in their respective districts, and to point out to such bodies the lines of joint concerted action in the public health field which are most likely to yield permanent and lasting results. In a similar manner the District Health Officers seek to encourage the public health sentiment already existing in such bodies as medical societies, district nursing associations, infant welfare organizations, parent teachers associations, and the like, and to direct their good will in lines of public health into ever increasingly effective channels.

(b) *Advice to Local Boards of Health.* — Another important function of the District Health Officer is to act as a general adviser to local boards of health. The wide range of occasion when local boards of health desire the advice and assistance of the District Health Officer is too obvious to need any further comment than to state that this work alone absorbs a considerable percentage of the time of the District Health Officer.

(c) *Supervision of Tuberculosis Dispensaries.* — Another most important function of the District Health Officer has been the establishment and supervision of the tuberculosis dispensaries of the larger

cities and towns. The details of this achievement and the difficulties involved are described in the report of the District Health Officers. Information as to the systems of keeping records by the dispensaries and of utilizing the results of their investigations for drawing general deductions on the tuberculosis problem of the State as a whole is described in the work of the epidemiologist.

(d) *General Public Health Educational Work.* — Another important field of the work of the District Health Officers involves general public health educational work throughout their districts. This work is carried on in close conjunction with the Division of Hygiene, and is under the general supervision of the director of that Division.

(e) *Inspection of Jails, Reformatories and Lockups.* — A routine duty of the District Health Officers is imposed upon them by the statutes calling for an inspection of jails and lockups, followed by their recommendations to local authorities as to the improvement of insanitary conditions when found. This work is, on the whole, unsatisfactory. It involves a considerable expenditure of both time and money. In general, it may be stated that the jails and reformatories are always found in excellent condition. As regards the local lockups, some are regularly found to be in good sanitary condition and are known to be so with practical certainty by the District Health Officer before he starts on his inspection. In the considerable number of instances in which conditions are found radically defective from a sanitary standpoint, neither the District Health Officer nor the State Commissioner of Health has any authority to bring about remedial changes. In many instances perusal of the reports for several years past will show that the District Health Officer has condemned the same condition in no uncertain terms and suggested the remedy therefor with unvarying regularity from year to year, and that the local authorities to whom his suggestions are addressed have continued to do nothing with equal regularity. In many instances, also, lockups are now being maintained by towns throughout the Commonwealth where there is no real occasion for the maintenance of such an institution.

(f) *Nuisances.* — The subject of nuisances is another one whose present status is thoroughly unsatisfactory. The State Department of Health has no authority whatever relative to nuisances. In a great preponderance of instances nuisance problems resolve themselves into simple questions of æsthetics or of neighborhood or personal controversies and wrangles.

Many years ago it was the universal belief that nuisances and obnoxious trades through their pollution of the atmosphere, and

all sources of filth in general, could of themselves produce contagious diseases. On the basis of this now thoroughly exploded theory boards of health have very generally been made the official keepers of the community's conscience, so far as nuisances are concerned, instead of the general police authorities, in whose province the great majority of them more properly belong. The residuum of nuisances in which a real public health problem can perhaps be unearthed is so small that there can be but little justification, from the standpoint of the public health, for the amount of time, energy and money that both the State and city and town boards of health are obliged to devote to these questions perennially. As matters now stand it is a common practice of local health authorities to endeavor to dodge the issue, when a nuisance question arises, by referring the matter to the State health authorities and giving the complainant to understand that the final decision in the matter rests with the State authorities, when the facts of the case are directly opposite.

(3) *Miscellaneous Work of the District Health Officers.*

(a) *Local Disease Records.* — During the past year the District Health Officers as a group have carried out several lines of special work that call for some comment. One of their minor tasks has been the replacing of the old contagious disease record book with a new form of record book drawn up by the Department under the authority of chapter 52, General Acts of 1915. This new form has now been adopted by practically all of the cities and towns in the Commonwealth. The local authorities have been most courteous in their co-operation in this matter.

(b) *Assistance to Wassermann Laboratory.* — Another special piece of work has been that of assisting the assistant director of the Wassermann Laboratory in getting started, as a routine practice, Wassermann examinations of the inmates of State institutions.

(c) *Typhoid Prophylaxis in State Institutions.* — Another special work has been the recommendation, although as yet but little followed, to the trustees of State institutions to have all of the food handlers of these institutions examined by epidemiological and laboratory methods by the State Department of Health in order to detect possible typhoid carriers among them, and to supplement this precaution by immunizing as a routine, with the antityphoid vaccine, all the inmates of such institutions. This policy was adopted by the State Department of Health following a serious outbreak of typhoid, due to a carrier working in the kitchen of one of the larger State insane insti-

tutions. The advantages of this procedure are so obvious, and the ease with which it can be carried out in institutional life is so manifest, that it is not a little surprising to note that many of the trustees of State institutions have taken official cognizance of this offer of assistance from the State Department of Health only to decline. Such being their attitude, the responsibility for any future outbreaks of typhoid in any institution cannot be justly placed upon the State Department of Health.

(d) *District Tuberculosis Hospital Resolve*. — During the present year another special piece of work that has taken a great deal of the time and thought of the District Health Officers has been the carrying out of chapter 136, Resolves of the General Court of 1915, approved May 28, 1915, for investigation and report by the State Department of Health as to the advisability of establishing county or district tuberculosis hospitals.

(e) *School Hygiene Investigation*. — The District Health Officers during the past year have devoted a good deal of time to an intensive investigation of the present status of school hygiene and medical inspection of schools throughout the Commonwealth.

(f) *Pasteur Treatment*. — Still another special line of work that has been the cause of no little anxiety and trouble to the Department has been that of administering the antirabic treatment to persons bitten by rabid or suspectedly rabid dogs. So much misunderstanding seems to have developed over the attitude of the State Department of Health regarding this matter that a little more explanation may not be amiss in this report. When this work was started cases requiring treatment were relatively few, and it was feasible to have the State District Health Officer handle the administration of the Pasteur treatment, in many instances going from place to place for this purpose. The work increased to such an extent, however, that the District Health Officers were frequently obliged to devote six or seven hours a day traveling about for the purpose of administering the treatment, and it was found to be necessary to notify the local boards of health that this was taking so much time from the other duties of the District Health Officers that patients desiring such treatment would either have to make arrangements to go at a definite, stated time to the residence of the District Health Officer for treatment, or it would be necessary for the family physician or the local board of health to purchase the treatment and administer it. Considering the relative public health significance of dog-bite cases, and all other work of the District Health Officers, and the fact that this method still provides

eight places in the State in which treatment can be had promptly and regularly, free of charge, while in all other States in the Union, to our best knowledge, patients are required to go to some one central point, although it may be several hundred miles, the medical profession, local boards of health and the general public of this State certainly have no cause for complaint in this matter.

In closing this outline of the activities of the District Health Officers it may not be inappropriate for the director to express his personal appreciation of the enthusiastic spirit with which each individual District Health Officer has taken up the duties of his position. The State Commissioner of Health is a strong advocate of the policy of getting into direct personal touch with local health authorities throughout the State, holding that failure to obtain that mutual co-operation that is so essential for successful public health administrative work between the State and local authorities is in most instances due to lack of the element of personal acquaintanceship, and hence the failure on the part of the State authorities to appreciate the difficulties and limitations, financial and otherwise, under which the local authorities are endeavoring to carry on their work.

In the pursuit of this policy, at the Commissioner's direction, the director of the Division of Communicable Diseases, early in the summer of 1915, began a series of visits to the local boards of health in each district, in company with the District Health Officer, and discussed their problems with him. The fact that the tuberculosis dispensaries were just being established in many of the towns of over 10,000 inhabitants rendered this policy of administrative visitation, for it would be obviously unfair to term such visits an inspection in any sense, peculiarly appropriate. It is very much to be regretted that pressure of work in the central office during the latter months of the year has prevented the complete carrying out of this plan of action; but as soon as possible this practice of local visitation will be resumed, and an endeavor will be made to make it more or less of an annual feature of the work of this Division.

MISCELLANEOUS AND SPECIAL WORK BY THE DIVISION'S PERSONNEL.

During the course of the year various members of the personnel of the Division of Communicable Diseases have been assigned by the Commissioner or by the director of the Division to certain special lines of investigations, or to act as representatives of the Department

on various occasions. This work, which has been allied to but not directly in line with the routine duties of the Division, has been rather varied and extensive.

1. SPECIAL WORK BY THE DIRECTOR.

(a) *Service on the Special Board of Investigation of the Milk Situation in Massachusetts.*

The director of the Division was assigned by order of the Commissioner to act on the special board of the Department charged with investigation of the milk situation in the Commonwealth. The duties of this milk board have been extremely exacting; in fact, it has absorbed a very considerable percentage of the time of all the members on it. As the subject is adequately covered in other parts of the Department's report, and the special report of the board will soon be forthcoming, it is not necessary to refer to the details of this work further at this point.

(b) *Service on School Hygiene Board.*

In a similar manner the director of the Division has served as a member of the committee of a special board investigating the present status of medical inspection of schools and school hygiene in general, including in this the instruction in sanitation and hygiene in the public schools throughout the Commonwealth.

(c) *Addresses by the Director.*

Since becoming associated with the Department the director of the Division has delivered 28 addresses on various topics of a public health nature before physicians, nurses, boards of health officials, women's clubs and mixed popular audiences.

(d) *Official Attendance at Public Health Meetings and Conferences.*

At the direction of the Commissioner, the director of the Division has attended several meetings and conferences of both formal and informal nature. The most important of these meetings were: —

The Annual Conference of State and Provincial Boards of Health of North America, held at Washington, D. C., May 14, 1915.

The Annual Meeting of the American Public Health Association, held at Rochester, N. Y., Sept. 6 to 10, 1915.

The Second Annual New England Conference on Tuberculosis, held at Springfield, Oct. 23, 1915.

Beside these meetings, which the director attended as an official representative of the Department, he has attended as a matter of course district meetings of associations of boards of health, the annual meeting of the Massachusetts Medical Society, and certain other health meetings and conferences within the Commonwealth, including the regular sessions of the Massachusetts Association of Boards of Health.

(e) Work on Popular Health Lectures.

Another special line of work to which the director of the Division has devoted a considerable amount of time during the past few months has been in assisting the director of the Division of Hygiene in arranging the details of the Department's popular health lecture course.

2. SPECIAL WORK BY THE EPIDEMIOLOGIST.

The epidemiologist has carried out numerous lines of special work in the interests of the Department. These may be briefly epitomized under the following heads: —

(a) Trips of Investigation.

The epidemiologist has made one important trip for the purpose of investigating both epidemiological and routine office matters of the New York City Health Department in reference to certain changes under consideration in this Department.

(b) Adjustment of General Office Routine.

Following the reorganization of the Department into divisions, it was found that there would need to be a considerable amount of readjustment of details of office routine. Owing to his previous extensive executive experience in office work, the epidemiologist was detailed by the Commissioner to formulate and put into effect a complete plan of readjustment of office work. This important duty has involved a large amount of time and effort, and is not yet completely finished.

(c) Addresses by the Epidemiologist.

The epidemiologist has made several addresses, principally before popular audiences. This work is carried out in collaboration with the Division of Hygiene, as a part of the general educational work.

(d) Educational Work by Epidemiologist.

The epidemiologist, to a much greater extent than the director, has actively collaborated with the Division of Hygiene in arranging details of the lecture work of that Division, especially in collecting material for stereopticon lectures.

Worthy of passing reference under this same heading are the regular contributions to the monthly bulletin by the epidemiologist. Included in the routine work of the epidemiologist is the duty of preparing the résumé of communicable disease prevalence for the monthly bulletin, besides contributing special articles from time to time.

(e) Inauguration of a Public Health Library Reference System.

Another piece of special work by the epidemiologist that is of far-reaching value to the Department as a whole is the matter of inaugurating a well-balanced public health library reference system and of reviewing and maintaining constantly an up-to-date index of current public health literature. As far as possible important articles are abstracted briefly and filed for convenient and speedy future reference.

The more important journals devoted exclusively to public health topics are assigned among the medical members of the Division of Communicable Diseases and reviewed by each one, and an abstract is furnished at each monthly conference of the District Health Officers. This procedure has proven a valuable means both of keeping the personnel of the Division in touch with the latest developments in public health procedure and also in adding to the efficiency of the public health library reference service.

3. SPECIAL WORK BY THE DISTRICT HEALTH OFFICERS.

On their own initiative within their own districts, so many special lines of investigation and of co-operation with local authorities are constantly being inaugurated and carried out by the District Health Officers that it would be tedious to take time to enumerate such activities. However, certain special lines of work by various members of the District Health Officer force deserve some brief reference.

(a) Attendance at Meetings and Conferences.

All but two of the District Health Officers attended the meeting of the American Public Health Association at Rochester, N. Y. It is worthy of passing comment to note that only one was sent as an

official representative of the Department. All the others who attended the meeting, five in number, went entirely at their own expense. Two of the District Health Officers, Dr. Hitchcock and Dr. Jones, attended the New England Conference on Tuberculosis at Springfield as representatives of the Department. In a similar manner as the director, the District Health Officers have individually attended numerous medical and public health meetings and conferences within their own districts or in other parts of the Commonwealth, including attendance at the meetings of the Massachusetts Association of Boards of Health.

(b) *Assistance to the Milk Board.*

Two of the District Health Officers, Dr. Hitchcock and Dr. Fish, have rendered extremely valuable assistance to the milk board of the Department. In fact, they have been practically although non-officially members of that board, actively carrying out investigations and assisting in the final preparation and editing of the report. To a more limited degree, several of the other District Health Officers have assisted in the field investigations into dairy conditions.

(c) *Editing Annual Reports.*

Some months after assuming the duties of the office, the director discovered that the report of the State Inspectors of Health for 1914 had never been edited for publication in the 1914 report. On investigating the matter he found that it had always been the policy in the past to have the editorial work for this report done in the central office. While this method of editing the report presents certain obvious advantages, it was determined that the future policy of the Department would be to have the District Health Officers, who are responsible for the work done in their districts, also responsible for the editing and preparation of the reports of this work. Therefore, one of the District Health Officers, Dr. Jones, was detailed to edit the 1914 report. Two other District Health Officers, Dr. MacKnight and Dr. Simpson, have in a similar manner served as editors for the 1915 report.

(d) *Addresses by the District Health Officers.*

The District Health Officers have severally made numerous addresses, for the most part of a popular character, on public health topics, both within their own districts and other parts of the Commonwealth, during the year. The most notable of these probably are

the addresses given at the joint conference held by the Massachusetts Association of Boards of Health and the State Department of Health in April, at which four of the District Health Officers spoke.

4. SPECIAL WORK BY THE BACTERIOLOGIST.

The bacteriologist has been so swamped with details of routine work that it has been impossible for her to carry out other laboratory research work to any extent, or to do much other public health work of a special character. She has, however, assisted the epidemiologist on two or three occasions by collaborating in field work in searching for suspected carrier cases, and has made some personal investigations as to the methods and technique followed by other diagnostic laboratories maintained by local boards of health. It is planned to have the bacteriologist study this phase of public health administration in the Commonwealth very thoroughly during the coming year. At the end of that time it is hoped that the Department may be able to present a well-balanced and completely worked out diagnostic laboratory policy for the consideration of both the local boards of health and, if occasion seems to indicate, for the General Court as well.

A BRIEF CONSIDERATION OF THE PRINCIPAL FEATURES OF THE COMMUNICABLE DISEASE PROBLEM OF THE COMMONWEALTH ARRANGED ACCORDING TO DEFINITE GROUPS OF DISEASES.

In working out definite lines of attack in the fight against preventable diseases it can easily be determined that the individual significance of the various communicable diseases varies to a very high degree. Some diseases that were once both extremely common and horribly fatal are, under present conditions in this Commonwealth, practically a negligible factor, both as to the fatality resulting from them and the total amount of sickness that they cause. Other diseases are extremely prevalent, and result in a great deal of loss of time, suffering to the individual and rather extensive dislocations of certain activities of community life, but do not exert any marked influence on the total mortality rate. Still other groups of communicable diseases are both very common and produce a considerable effect upon the fatality rate in the community.

The remainder of this report will be taken up with a skeleton sketch of the problems that certain groups of communicable diseases present in a practical health administrative sense.

In this general consideration of communicable disease problems the figures employed for both cases and deaths are for the year of 1914. In all other parts of this report statistics of disease relate to the year 1915; but for purposes of this report it was impossible to obtain segregated reports of causes of death for the year 1915.

GROUP A.

This group comprises certain serious and formerly extremely common causes of both sickness and death within the Commonwealth, but which are now well controlled, relatively speaking. The means of transmission of this group of diseases are well known, and the proper preventive measures have been for some time worked out and are now quite generally applied. They do not represent a large percentage in the mortality rates. The diseases in this group are malaria, smallpox and typhoid fever.

Lines of Attack.

The practical lines of attack that are available for this group may be epitomized as follows: prompt reporting by physicians; proper degree of isolation carried out by the local health authorities; prophylactic vaccine (for smallpox and typhoid fever); proper application of the principles of sanitary engineering (for malaria and typhoid); proper sanitation of foods, including milk (for typhoid fever). For the entire group, further extension of education of the public in the principles of public health.

The total number of cases reported for this group for the year of 1914 is 2,377, distributed as follows:—

Typhoid fever, ...	2,333
Smallpox, ...	38
Malaria, ...	6
Total, ...	2,377

The total number of deaths reported for this group for the year 1914 is 276, distributed as follows:—

Typhoid fever, ...	268
Smallpox, ...	—
Malaria, ...	8
Total, ...	276

This total represents only .5 of 1 per cent. of the total deaths of the Commonwealth.

GROUP B.

This group includes certain diseases whose causes are well understood and whose means of transmission are reasonably well known, but which, for a variety of reasons, are as yet inadequately controlled in the Commonwealth. They have a very large percentage in the mortality rates, and the total economic and humanitarian loss due to their prevalence is almost incalculable. The diseases in this group are diphtheria and tuberculosis in all its forms.

Lines of Attack.

The lines of attack available for this group are many and varied. There is every reason to believe that still greater concentration of effort along the same lines that have been followed in the past will result in continued decrease in both the frequency and fatality of these two justly dreaded diseases. The principal lines of attack are: prompt reporting by the physicians; prompt isolation by the local health authorities (for diphtheria); modified isolation (for certain types of tuberculosis); wider utilization of laboratory facilities for diagnostic purposes; wider utilization of the public health tuberculosis dispensaries; extension of the practical application of the principles of child hygiene and school hygiene; wider extension of public health "nursing" service; strict sanitary control of the milk supply, including extension of pasteurization, improvement of housing, individual hygiene, personal hygiene, industrial hygiene, extension of the public health education and extension of the practice of hospitalization.

The total number of cases reported for this group for the year of 1914 is 15,794, distributed as follows:—

Diphtheria, ...	8,080
Tuberculosis, pulmonary, ...	7,144
Tuberculosis (other forms), ...	570
Total, ...	15,794

The total number of deaths reported for this group for the year of 1914 is 5,713, distributed as follows:—

Diphtheria, ...	652
Tuberculosis, pulmonary, ...	4,171
Tuberculosis (other forms), ...	890
Total, ...	5,713

This total represents 9 per cent. of the total number of deaths; in other words, one of the greatest problems of the communicable disease prevalence in the Commonwealth centers in this group of cases.

GROUP C.

This group comprises diseases whose etiology and means of transmission are thoroughly well understood, whose means of prevention are quite definitely known and, to a limited extent, practically available. The group represents beyond question a very large, but as yet unrecognized and undeterminable, percentage in the total mortality rates. In the aggregate probably no other group of communicable diseases produces as much human suffering and misery, as much impairment of the efficiency of the human machine, as much individual family and community impairment as do these diseases. Added to these features, which might in a sense be attributed to any communicable disease, are other features of the gravest importance to the State and the nation. The first of these is the far-reaching adverse effects of these diseases upon the general birth rate of the community, and the tendency of those infected with these diseases to bear children stillborn or those of a physically defective type that are born alive. Other tragic effects of the prevalence of these diseases are of the most far-reaching consequence, tending as they do to disrupt the very foundation of society itself through their sinister influence on the family unit. The ramifications of this last group of effects of these diseases extend far beyond the realms of public health into those of public morals and social or community economics. These effects are due partly to the high degree of permanent invalidism the diseases themselves produce, and partly to the tendency of one of the diseases of the group to produce the most terrible and, for the community at large, the most expensive of all maladies, — insanity. The diseases in this group are syphilis and gonorrhœa.

Neither of these diseases is at the present time reportable in the Commonwealth; hence it is impossible to give any statistical data which will even remotely approximate their actual prevalence. But as some slight indication of the widespread prevalence of both these diseases there might be cited a well-known fact that fully 50 per cent., if not more, of all pelvic operations are more or less remotely due to an earlier infection of gonorrhœa by the patient.

Some suggestive, but as yet seriously incomplete, investigations of the Wassermann reaction, taken from a group of persons who were not seeking medical or surgical advice for the actual treatment of the

disease itself, tend to indicate that syphilitic infection is prevalent to at least 10 per cent. frequency in the general population of the industrial centers of the Commonwealth.

The mortality statistics for these two diseases are well-nigh as hopeless as the morbidity statistics. It is very safe to say that probably not over 3 to 5 per cent. of the fatalities that are fundamentally the result of prior syphilitic infection ever appear on the death returns as such. It is possible, and even probable, that neither the immediate nor remote fatality effects from gonorrhœa begin to equal those of syphilis. But it is well known to all medical men that the fatalities which are actually due to the last analysis of infection with gonococcus are much greater than is popularly conceived.

Lines of Attack.

The principal lines of attack that are practicable in the campaign against these diseases are, roughly, as follows: Widespread utilization of laboratory service for the diagnosis of these diseases, including the Wassermann reaction for syphilis, and complement-fixation reaction for gonorrhœa, and immediate microscopical examination for the gonococcus and the spirachæta for both. For syphilis, systematic treatment of active syphilitics, with the object in view of reducing the number of individuals who can act as foci of infection. This measure is now entirely practicable through the utilization of salvarsan. For gonorrhœa no process has yet been devised that will accomplish results similar to those of salvarsan. Two other great lines of attack lie open in the struggle against these diseases; they are public health education and hospitalization. Finally, in trying to arrive at a conclusion as to the relative practicability of agents in the struggle against these justly termed social maladies, it is of the utmost importance to remember that for the very reason that they are in no small degree social problems, moral education must go hand in hand with public health education if ultimate satisfactory results in diminished prevalence of these diseases are ever to be achieved.

GROUP D.

This group includes certain communicable diseases that attack the respiratory passages. As a group there is the widest possible range in the seriousness of the individual diseases, yet in many instances it is possible to draw a sharply defined line between various diseases of the group. As yet it can scarcely be said that the science of preventive medicine has made any marked effect upon either the prevalence or fatality of these diseases.

Although their cause is fairly well known from a bacteriological standpoint, yet the germs that are considered universally to be the exciting cause in all the diseases of this group are so widely distrib-

uted in the throats of normal, healthy individuals, and the conditions which result in these germs changing from apparently entirely harmless permanent residents of the respiratory passages to acutely disabling or even frightfully virulent organisms are as yet so little understood, that it is impossible to outline any proper lines of attack with any such assurance that they are logical, as can be done in the cases of many other communicable diseases.

The more serious diseases of this group, the pneumonias, have a very great percentage importance in the general mortality rates. The economic and social burden of the nonfatal cases of the pneumonias upon the community is in the aggregate large, although not to be compared with the morbidity burden of tuberculosis, because of the extremely acute nature of the great majority of cases of illness from the causes now under consideration.

Even the more trivial diseases of this group, the very name of which is standing evidence of their universal prevalence, the so-called "common colds," not only are directly responsible in the aggregate for a very great amount of lessened efficiency of the human machine in this Commonwealth every year but, from these so-called "common colds" such serious disorders as tonsillitis, ear abscesses, meningitis, purulent infections of the bony cavities of the face and skull can and do arise. All of these maladies either destroy many human lives annually, or else lead, after most serious and prolonged illness, to serious surgical operations. Furthermore, tonsillitis, often lighted up by the preliminary cold, can be held responsible in a large number of cases for many serious diseases which first manifest themselves at a considerable distance from the originally offending tonsil. The diseases in this group are acute coryzas (common cold), the various types of acute bronchitis, bronchial pneumonia and lobar pneumonia.

Lines of Attack.

Although there has been some hopeful work done along lines of preparation of specific vaccines for the pneumonias, as yet none of these results have become of widespread practicability in the struggle against these diseases. There is a great deal of cumulative evidence that goes to show that, from a practicable public health standpoint, the best lines of attack in coping with these maladies that we know at present lie in the direction of proper personal hygiene, including in this such things as proper clothing, proper hours of work, adequate amount of sleep, avoidance of undue exposure to rapidly changing extremes of temperature, fresh air, moderation of eating and drinking, etc.

Inasmuch as none of the diseases of this group are at present reportable, it is impossible to even approximately estimate the preva-

lence of even the serious pneumonias in the Commonwealth. But the evidence of the death returns demonstrates conclusively that in this is one of the major, and as yet entirely unsolved, problems of disease prevention.

The total number of deaths reported for this group for the year of 1914 is 5,987, distributed as follows:—

Bronchial pneumonia, ...	2,594
Lobar pneumonia, ...	2,804
Indefinite diseases of respiratory passages, ...	589
Total, ...	5,987

This total represents 11.1 per cent. of the total number of deaths recorded in the Commonwealth for that year.

GROUP E.

In this group are comprised certain diseases whose etiology is imperfectly known, but whose relative rate of infectiousness is, for the most part, extremely high. Both their immediate and remote percentage in the mortality rates is relatively noteworthy, although not to be compared with the groups just preceding. Unfortunately, however, both their serious significance as direct causes of death, and the permanent bodily impairment in the shape of lessened resistance to other diseases that they so often produce, are as yet very feebly recognized by the general public.

Because of the extremely contagious nature of most of the diseases in this group, and the fact that the definite cause of most of them is yet uncertain, they represent a peculiarly difficult problem from the standpoint of epidemiology. One of them, scarlet fever, has managed to impress its serious nature upon the general public for some time past. This has been due, undoubtedly, to the fact that, while not as widespread as the other maladies in the group, its percentage fatality is much higher and its obvious intermediate serious complications are much more frequent. It is probably largely due to this greater popular dread of this disease that, it may be fairly stated, it alone among the entire group is at the present time reasonably well controlled, and seems at present to be markedly on the decrease in the Commonwealth. The diseases in this group are measles, the so-called streptococcic infections of the throat (a comparatively poorly defined group of infections), scarlet fever and whooping cough.

Lines of Attack.

The lines of attack in this group of diseases may be epitomized as follows: first of all, wider public health education as to their significance, particularly wider education of parents. Other elements in any successful effort against these diseases must include such matters as prompt reporting; isolation; extension of public health nursing and of the principles of school hygiene; guarding of the food supplies (especially milk in connection with scarlet fever and the streptococic throat infections); and, to a limited extent as yet, specific vaccine therapy.

The total number of cases reported for this group for the year of 1914 is 26,573, distributed as follows: —

Measles, ...	12,264
Streptococcic infections of the throat, ...	36
Scarlet fever, ...	11,057
Whooping cough, ...	3,316
Total, ...	26,673

The total number of deaths reported for this group for the year of 1914 is 725, distributed as follows: —

Measles, ...	149
Streptococcic infections of the throat, ...	105
Scarlet fever, ...	246
Whooping cough, ...	225
Total, ...	725

This total represents approximately 1.3 per cent. of the total deaths of the Commonwealth for the year. While this showing does not indicate that this whole group is a major factor in the fatality problem of the Commonwealth, it is always necessary to bear in mind that in practically all of the diseases of the group (but especially measles and whooping cough) the diagnoses on the death returns do not by any means indicate the true fatality of these diseases. It is probably safe to assume that this whole group of diseases is immediately responsible for between 3 to 5 per cent. of the total fatalities.

GROUP F.

In this group are classed certain communicable diseases whose etiology is fairly well known, but whose means of transmission are as yet but imperfectly known, and which exhibit a rather peculiar

phenomenon in that they do not remain regularly prevalent, but exhibit most striking variations both in their prevalence and in their percentage importance in the mortality rates from year to year.

One of them, influenza, is a difficult disease to either describe or to grapple with in a practical public health sense, inasmuch as the very term "influenza" itself is used in a loose and varied sense. There can be no question that there exists a specific infectious disease which exhibits, with the possible exception of bubonic plague, the greatest tendency of any known disease to travel from time to time all over the known world, and which, at the time of such invasions, presents very serious features. But the term "influenza," or la grippe, is used also to designate, in a loose and poorly defined sense, many of the common milder infections of the respiratory passages which are more properly grouped under the heading of "bronchitis."

Just at the present time serious and extremely fatal epidemics of true influenza are prevalent in many of the middle western and central Atlantic seaboard States. The disease has not as yet manifested itself in epidemic form in this Commonwealth. Whether it may later in the winter become serious is entirely problematical, as we have no reliable means of averting its spread.

The total number of cases reported for this group for the year of 1914 is 332, distributed as follows: —

Anterior poliomyelitis (infantile paralysis), ...	151
Epidemic cerebrospinal meningitis, ...	181
Influenza, ...	— ¹
Total, ...	332

The total number of deaths reported for this group for the year of 1914 is 201, distributed as follows: —

Anterior poliomyelitis (infantile paralysis), ...	45
Epidemic cerebrospinal meningitis, ...	156
Influenza, ...	129
Total, ...	330

This total represents .6 of 1 per cent. of the total deaths of the Commonwealth for that year.

¹ Not reportable.

Lines of Attack.

The lines of attack are: better control of birth returns, distribution and utilization of silver nitrate prophylactic on new-born babies, prompt reports of beginning cases, strict isolation and hospitalization for ophthalmia neonatorum, medical school inspection, inspection of industrial employees, prompt reporting and isolation for trachoma, and more widespread public health education in regard to the significance of both these diseases is extremely important.

The total number of cases reported for this group for the year of 1914 is 2,666, distributed as follows: —

Ophthalmia neonatorum, ...	2,620
Trachoma, ...	68
Total, ...	2,688

There were no deaths reported from these diseases for the year of 1914 in this Commonwealth.

GROUP I.

This group comprises diseases that have practically infinitesimal percentage importance in the mortality rates, but which possess a peculiar importance either from popular dread with which they are regarded, in the case of some of them, or because of their utterly hopeless character from the standpoint of fatality when once contracted in the case of others, and because of their relative rarity in the case of all of them. The diseases in this group are anthrax, actinomycosis, glanders, leprosy, rabies and tetanus.

Lines of Attack.

The lines of attack are: the control of infectious diseases of animals for anthrax, actinomycosis, glanders and rabies; prompt reporting, isolation, public health education for all; preventive antirabic treatment and quarantine control of rabie animals for rabies; and permanent segregation for leprosy.

The total number of cases reported for this group for the year of 1914 is 50, distributed as follows: —

Anthrax, ...	8
Actinomycosis, ...	4
Glanders, ...	3
Leprosy, ...	1
Rabies, ...	6
Tetanus, ...	31
Total, ...	53

The total number of deaths reported for this group for the year of 1914 is 38, distributed as follows: —

Actinomycosis, ...	—
Anthrax, ...	1
Glanders, ...	3
Leprosy, ...	1
Rabies, ...	5
Tetanus, ...	28
Total, ...	38

This total represents such an infinitesimal percentage of the total deaths of the Commonwealth for the year that, from the standpoint of saving lives in the mass, this group of diseases may be considered as entirely negligible. However, their individual seriousness is so great as to justify most extreme measures of precaution in order to prevent them from ever becoming more serious causes of death in a quantitative sense.

NEW LINES OF WORK RECOMMENDED.

Along the lines of general future development of this Division, I would most earnestly recommend to the Council the following broad lines of policy to be worked out as occasion and future circumstances may best determine: —

1. The extension of the principle of public health nursing service in such a manner that, as soon as possible, one or more trained public health nurses for each health district may be placed in the field as permanent assistants to the District Health Officers.

2. That definite plans be made for radically changing the present system of reporting communicable diseases. The present form of postal notices does not furnish such fundamental data as the occupation of the patient, milk supply, water supply, school attendance

and the name of the reporting physician. The forwarding of the original reports of cases to this Department is the ideal to be desired. This information will serve as a rational basis for the more prompt and thorough control of communicable diseases.

3. That the Division make careful plans for such future enlargement of laboratory service as we must be ready to furnish if our laboratory facilities are going to keep in step with our increasing thoroughness of epidemiological control in the field. The principal problems involved in the question of further extension of laboratory service are covered in more or less detail in the body of the report.

REPORT OF EPIDEMIOLOGIST.

The position of epidemiologist was created on June 1, 1915. The object of this addition to the Department was twofold, — to supplement the investigations of the District Health Officers in the field in especially difficult or obscure outbreaks of disease, and to keep in close touch with the whole problem of communicable disease from the office.

The first step after the establishment of this position was a survey of the present methods and conditions. Upon the results of this study was based the plan of action which promised to be of the most service to the Department. This survey revealed several important things. It showed almost immediately the inadequacy of the office records upon which to judge the presence and spread of communicable diseases. It confirmed the opinion that there was need of some one to co-operate with the District Health Officers in their investigations, complete such investigations when they were called to other fields, and to make special studies of difficult epidemiological problems. Finally, it revealed the absolute necessity of a good follow-up system in our epidemiological work if a proper estimate was to be placed upon the relative values of the various investigations.

FUNDAMENTALS OF EPIDEMIOLOGICAL CONTROL.

The United States Public Health Service heads its morbidity reports with this statement of fact: —

No health department, State or local, can effectively prevent or control disease without a knowledge of when, where and under what conditions cases are occurring.

We should like to add to this statement that this information should be received *promptly* and the cases *investigated thoroughly*. No real, permanent control of disease can be had with anything less than this.

The fundamentals of epidemiological control are —

1. *Prompt* reporting of all cases of communicable disease.
2. Prompt and thorough investigation of all outbreaks of communicable disease.
3. An adequate follow-up system to check the value and correctness of our epidemiological diagnoses.

4. Complete records.

With this information, plus sufficient statutory powers, there can be established an efficient, economical administrative control of communicable diseases. By these standards we have tried to judge the efficiency of the epidemiological work in the Department.

REPORTING OF DISEASES.

The statutory requirements for the reporting of diseases declared to be dangerous to the public health to this Department are as follows: The physicians and householders are required to report such diseases to the local board of health in the city or town where they are located. This is done upon postal cards furnished by the local board of health. In turn the local board of health, within twenty-four hours, is required to report all such diseases to this Department. These reports are made upon a double postal card furnished by this Department. Through voluntary co-operation by local boards of health a duplicate of this report is mailed directly to the District Health Officer. These cards contain the following data: the date of the report, the name of the disease, the name and address of the patient.

This system is not entirely satisfactory. Its advantages are that it brings prompt reports and that its cost is comparatively small. The disadvantages are that the reports lack important details upon which to base administrative action. They compel the District Health Officer or epidemiologist to look up all of the missing details in the records of the local board of health, or obtain them from the attending physician, before he can begin an investigation. In many places these records are poorly kept and inaccessible. The custodian frequently keeps them at his home and not at the municipal building.

The new contagious disease record book adopted within the last year is one step forward in the effort to overcome the above difficulty. It is a means of recording very valuable data if it is well kept. It gives a detailed account of all cases of diseases declared to be dangerous to the public health from the time of their being reported to the time of their termination. From these books the investigator can get the details necessary for planning an intelligent investigation of any particular disease. This book fails in two particulars: first, it is not properly kept by many local agents; second, these records, being in the hands of the individual local board of health, do not give this office the information which it needs in its effort to control communicable diseases. Consequently, it cannot replace the forwarding of original records to this office. An endeavor should be made to bring this latter system into effect as a distinct saving in time and aid to greater efficiency.

INVESTIGATIONS OF DISEASES.

Promptness and thoroughness are prime essentials in this branch of our work. In order to accomplish this several things are required, — sufficient statutory powers, co-operation of local health officials and interdivisional co-operation. We have sufficient statutory power for our investigations. In the majority of cases we are getting the active co-operation of the local authorities. While there has been constant co-operation between the various divisions, there remain many ways in which this co-operation can be made closer and more efficient.

Epidemiological investigations are initiated either by the District Health Officer or by the director of the Division of Communicable Diseases. The usual procedure is for the District Health Officer to make the preliminary investigation, and, if necessary, to call upon the diagnostic laboratory or the other divisions for assistance in their particular line of work.

The investigations of outbreaks of disease are usually very promptly made. This is true in spite of the system, not because of it. The long experience of the District Health Officers, plus the excellent memory of some of the office force, has kept a fairly close check upon dangerous outbreaks of disease. This uncertainty has been largely due to a failure to properly record in usable form returns of diseases.

The thoroughness of the Department's epidemiological studies still leaves much to be desired. Many individual studies have been complete and satisfactory. On the other hand, the reports from many investigations lack important details that are essential for the satisfactory judgment as to the efficiency of the investigation. This does not mean, necessarily, that effective administrative action has not been taken, but rather that complete reports have not been rendered to the office. The multiple and varied duties of the District Health Officers render it difficult for them to spare the time to make the more thorough epidemiological investigations that are so necessary to gain a maximum of benefit from past experience.

REINVESTIGATION OF DISEASES.

The final judgment of the value of epidemiological work can be determined only by a carefully planned follow-up system. There is no doubt that large sums of money have been spent in the past by departments of health throughout the world for investigations now known to have been useless. This has frequently been because of a false conception of the causation of disease, and was excusable. With our modern knowledge of the sources and modes of infection these

errors can be the result only of a lack of a follow-up system and a proper evaluation of the various lines of investigation.

In this respect the work of the Department has been seriously defective. While the District Health Officers in their routine work check up the aftermath of epidemics of disease, no systematic effort has been made to record this work and use it as a basis for future action. This is a vital defect and demands careful consideration.

RECORDS.

The necessity of accurate, plainly kept records is fundamental to the study of any disease, for upon the conclusions drawn from these records should be based all rational administrative action. The accumulated records of communicable diseases in this Commonwealth are invaluable. While there were defects in the method of reporting and recording these diseases, the system has produced one of the greatest collections of reliable data upon which to construct an efficient epidemiological control. Nevertheless, judged by modern standards of epidemiological work, the old system of contagious disease records in this office did not yield reliable information upon which to base a correct judgment of values.

RECORD SYSTEM.

The contagious disease record system required almost complete reconstruction. It has been necessary to train a statistician, develop a satisfactory comparative record form, and to find some simple graphic methods.

The basis of administrative control of communicable diseases is a satisfactory standard by which to judge their variation. This standard can be constructed from the past experience of any community with any particular disease. On this basis a card has been devised for each city and town in the Commonwealth showing the following information:—

1. Daily incidence of each reportable disease.
2. Monthly incidence of each reportable disease for the corresponding month of the previous year.
3. A monthly endemic index for each disease. (Endemic index signifies the average of five years of reported cases exclusive of epidemics.)
4. Weekly totals of deaths from reportable diseases.
5. Monthly totals of cases and deaths from all reportable diseases.

The endemic index for a city or town for a given disease is a standard constructed from the "normal" experience of that city

or town for the given disease. By checking this standard against the daily incidence of cases for the current month and the previous month we can detect promptly any unusual prevalence of the disease. This record, then, will furnish the necessary information for administrative action.

To supplement these records the epidemiological reports of the District Health Officers have been standardized. The expense accounts and the reports of diseases and investigations have been separated.

An epidemiological summary upon the accompanying form, including all important data, is now being submitted for each investigation of communicable disease. This in turn is checked against the morbidity card. This indicates whether the District Health Officer is in touch with the local situation.

(Date).....

(District).....

EPIDEMIOLOGICAL SUMMARY.

..... (Disease.) (Place.) (Date.)

Initiated by —

Reason —

History —

D. H. O.'S investigation —

Results —

Itinerary —

(Signature).....

Graphic methods are a valuable aid to administration when they are not too complex. After considerable study it was decided to use a chart for each disease, showing the cumulative curve of cases and deaths for the current and previous years. This will furnish another check for the detection of any abnormal communicable disease in the State.

The importance of accurate, usable vital statistics demands attention. In order that these might be furnished to the Department, it has been necessary to especially train one of our clerks along this line. Considering the fact that the vital statistics of the Commonwealth are not under our control, the amount of useful service that has been derived from this move is gratifying. The aim is to standardize all the statistics and furnish uniform reliable figures for the use of the entire Department.

The development of a "follow-up" system has had to await the institution of our more complete system of contagious disease records. However, while this is being completed, definite efforts are being made to begin systematic reinvestigations of outbreaks of diseases. These efforts have already demonstrated the value of this procedure as a basis upon which to evaluate the various lines of epidemiological investigation.

DIAGRAM SHOWING CUMULATIVE CURVES of CASES of VARIOUS DISEASES

REPORTED 1914. —●—●—●—
REPORTED 1915. —————

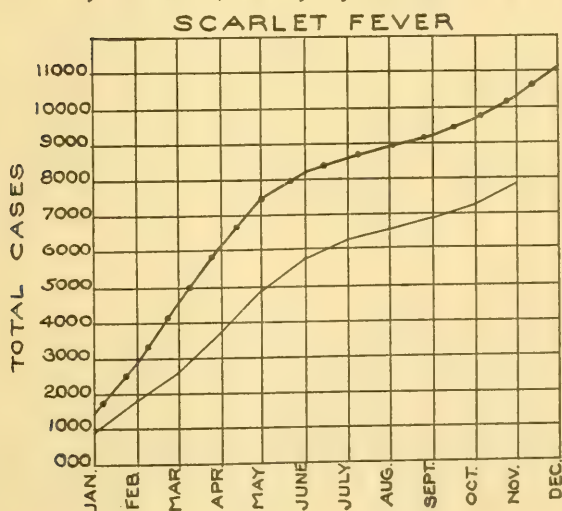
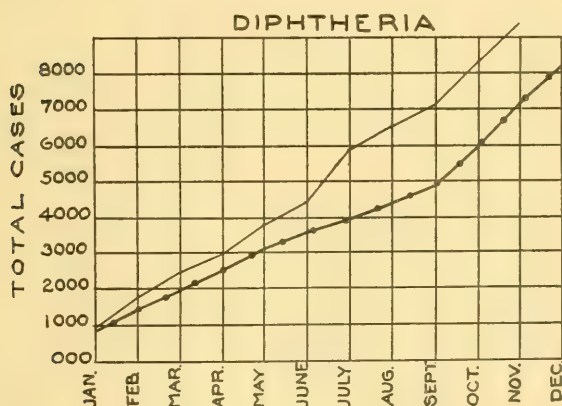
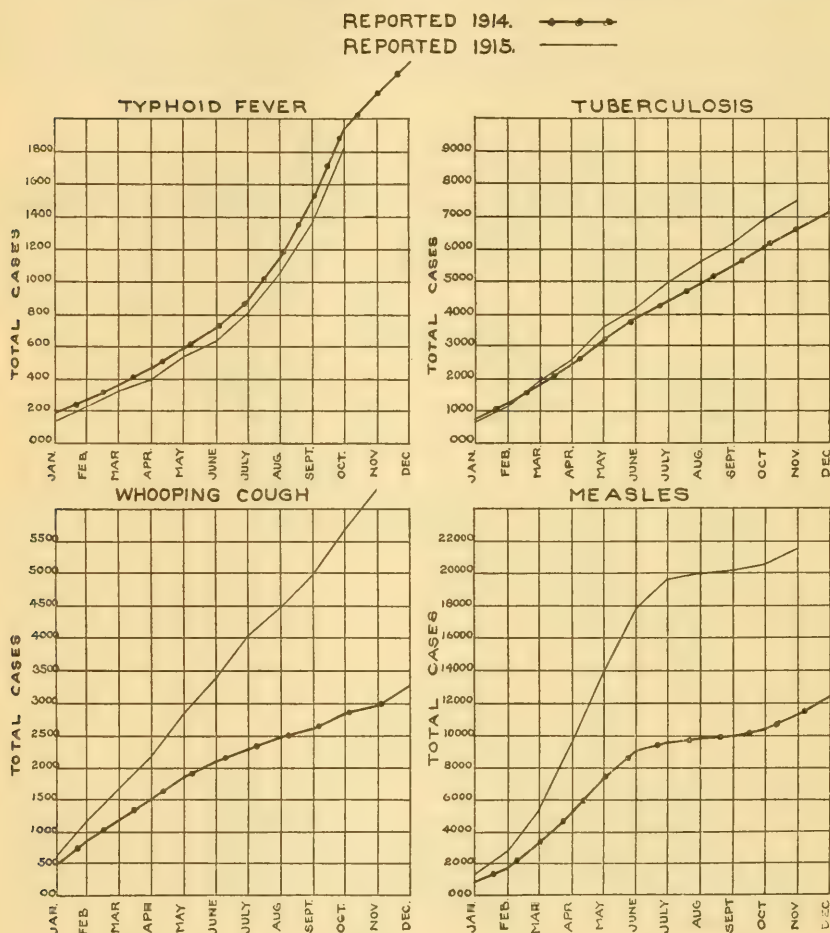


DIAGRAM SHOWING CUMULATIVE CURVES of CASES of VARIOUS DISEASES



SCOPE OF EPIDEMIOLOGICAL WORK.

The primary function of epidemiological investigation is the tracing of sources and routes of infection of the communicable diseases. The opinion of Hill has become well established. He says:—

The general statement holds true that the infectious diseases are spread chiefly by the transfer of discharges from the orifices of the infected body to orifices (chiefly the mouth and nose) of the prospective victim, and that were

infected discharges prevented from entering mouths and noses of well persons, the ordinary infectious diseases (except syphilis and gonorrhœa) would become great rarities and finally disappear.

With these principles as a basis, epidemiological work falls naturally into two divisions:—

(a) Statistical epidemiology.

(b) Field epidemiology.

These two branches of investigation are interdependent and supplementary. The statistical epidemiology has been discussed under the head of "Records." An outline of field epidemiology is needed to properly appreciate the relative importance of our epidemiological problems.

For purposes of description the field work should be considered under the heads of "Emergency" and "Routine Epidemiology."

Emergency epidemiology is done in the face of an already established outbreak of disease. The work is done under pressure, against time, and to cut short an already serious situation. This is the kind of epidemiological investigation that this Department is called upon to do in this State.

Local routine epidemiology applies the same methods for the same ends, but applies them continuously, day by day, systematically, and without haste. It consists, essentially, in prompt, thorough investigation, recording and study of each case of communicable disease as it occurs. The general practice of this type of epidemiological investigation would render the need for the more spectacular emergency type of investigation very infrequent. In some of the cities and towns of the Commonwealth this detailed work is being done. In these places all that is needed for a satisfactory knowledge of communicable diseases is a close co-operation between the District Health Officer and the local health officials. If in addition to this there is careful co-ordination between the District Health Officer, the diagnostic laboratory and the other special divisions of the Department, we have a most efficient system of epidemiological diagnosis. The encouragement of local authorities to adopt this system of routine epidemiological investigation should be one of our main lines of endeavor in the future.

Since the transmission of the major portion of diseases depends upon the exchange of human discharges, the problem of the epidemiologist resolves itself into a search for the sources and routes of infection. This information is desirable for all of the communicable diseases. Fortunately, the sources of infection fall into a few important groups.

Sources.

- (a) Discharges from the nose and throat: —
Tuberculosis.
Diphtheria.
Scarlet fever.
Smallpox.
Chickenpox.
Measles.
Leprosy.
Epidemic cerebro-spinal meningitis.
Human glanders.
- (b) Contracted from infected discharges from the outlets of bladder or bowels: —
Typhoid fever.
Gonorrhœa.
Some cases of tuberculosis.

The routes by which these discharges enter the body of the prospective victim are two main types: —

- (a) Primary or direct: —
Food.
Drink.
Eating utensils.
Air (mouth spray).
Hands.
Body contact.
- (b) Secondary or indirect: —
Hands.
Flies and other insects.

To trace out these sources and routes of infection for all of the communicable diseases, to demonstrate where and how these can be rendered harmless, to record this information in a permanent usable form, and then, with the co-operation of other health authorities, the medical, nursing and teaching professions and the general public, *to do it*. This is the service that the public health demands of epidemiology.

EPIDEMIOLOGICAL PROBLEMS IN MASSACHUSETTS.

An analysis of the returns of cases and deaths due to diseases declared by this Department to be dangerous to the public health indicates some very definite problems for solution.

Considered from a quantitative standpoint, the individual diseases stand out in the following order, according to the reports received by

this office during the period Nov. 1, 1914, to Oct. 31, 1915. The number of cases are reasonably accurate, but the deaths are undoubtedly incomplete because of the faulty method of reports.

	Cases.	Deaths.
Tuberculosis (all forms), ...	8,868	3,694
Diphtheria, ...	9,282	645
Scarlet fever, ...	8,613	189
Typhoid fever, ...	2,204	196
Measles, ...	22,881	142
Epidemic cerebro-spinal meningitis, ...	145	95

To this list of cases and deaths should be added those from pneumonia, and also those due indirectly to syphilis and gonorrhœa.

From these diseases the annual vital and economic waste is appalling. It demands the concentration of the forces of this Department upon certain of the more important of these problems. For purposes of discussion the individual diseases will be considered in the order noted in the above table.

Tuberculosis.

This disease still remains among "the captains of the men of death." Notwithstanding the cumulative knowledge of its nature, cure and prevention, the progress in its control seems to be out of proportion to the amount of time and money spent. This does not mean that our efforts have been or are being wasted, but merely that there remain some elements in the epidemiology of this disease to which we have not given due weight. Consequently, the attention of the Department has been concentrated upon a thorough study of the tuberculosis situation in the Commonwealth.

The attempt is being made to apply to this disease the fundamentals of epidemiological control as stated earlier in this report, viz., prompt reporting, thorough investigation, adequate follow-up work and complete records.

Accordingly, the following method of procedure with reference to tuberculosis has been adopted for the recording and utilizing of information obtained by this office:—

- I. Recording of information received at the central office (State Department of Health).
 - A. Each case of tuberculosis reported to State Department of Health is indexed (outside of Boston) and filed by cities and towns, and alphabetically by names.

- B. Every case of tuberculosis brought to attention of State Department of Health is noted and filed by cities and towns, and alphabetically by names. Sources: 1. Applications for admission to State sanatoria. 2. Admissions¹ to State sanatoria. 3. Discharges¹ from State sanatoria. 4. Correspondence.
- C. Each death noted, checked and filed by cities and towns, and alphabetically by names. (If case has not been reported, record made on brown card will show that first notice of case was through death report.)
- D. Observations of positive sputum examinations in State laboratory.
- E. Noting aliens afflicted with defects that would indicate a disposition to tuberculosis, and filing by cities and towns, and alphabetically by names.
- II. Oversight and supervision by the State District Health Officers, who get information in cities and towns of 10,000 inhabitants or over through dispensaries, local authorities and hospitals, or, if deemed necessary, special investigation.
 - A. Inspection of dispensaries and hospitals.
 - B. Submitting information for filing and scrutiny.
- III. Attention to letters with references to ex-sanatorium patients as deemed necessary, taking into consideration the dispensary supervision of these patients.
- IV. First-hand information obtained by the State District Health Officers in towns of less than 10,000 inhabitants, or, through co-operation with other agencies, on special cards prepared for the purpose.
 - A. Submitting of same to central office for filing and scrutiny.
- V. Outgoing information to State District Health Officers from central office of cases which may not otherwise come to the attention of these officers, including monthly report of conditions in district observed through checking system. (Extension of record system.)
- VI. Distribution of literature.

To illustrate this method of procedure the following hypothetical case is recorded: —

I. A. — Each case of tuberculosis reported to the State Department of Health (outside of Boston) is indexed on a green card, viz., the name of city or town and date of report to local board of health, form of tuberculosis, name of person, street address and any other information given on postal card.

¹ To be extended to local institutions after January, 1916.

ATTLEBORO, January 1, 1915.

Pul. Tb. — Jones, John

200 Meredith Street.

Also reported to Fall River board of health January 8, 1915, from
City Hospital.

This card will be filed under the city of "Attleboro," in "J."

If a report is made of one person from more than one town a cross reference is made, and if more than one report of a person is made from one town, each date of report is placed on the one card bearing the person's home address. A person is counted but once.

It is apparent that some local boards do not look up their records to see if a case has already been reported. Consequently, duplicate reports are constantly being received at the central office. This makes a community appear responsible for more cases than it really has. Through this checking system we will ascertain the true situation. For instance, if it should happen that John Jones was sent to a hospital in Fall River, and the Fall River board of health should report the case, a card like the following would be made out, but the case would not be considered a Fall River case. Since it had been counted once it would not be counted again. And if the case of John Jones should be reported again later in the year from Attleboro the date would be placed on the card bearing John Jones's name, but he would not be counted again. This Fall River card, recording case of John Jones, is considered as a part of the original Attleboro card. Attleboro being the home of the patient, any subsequent information will be filed under the city of Attleboro.

FALL RIVER, January 8, 1915.

Pul. Tb. — Jones, John

200 Meredith Street

Attleboro.

"In City Hospital."

See report made to Attleboro board of health January 1, 1915.

B. — Through a co-operative arrangement between the State Department of Health and the Massachusetts Trustees of Hospitals for Consumptives there is received in the office of the State Department of Health each week (usually Monday morning) a list of names and addresses of persons applying for admission to the State sanatoria. This list also contains addresses of the physicians making applications and dates of applications. When this list is received it is first observed whether the names on the list have been indexed. For instance, the first name on the list may be John Jones from Attleboro, his physician making application on January 9. The Attleboro file is consulted, and we find that John Jones was reported to the local board of health on January 1, and that between January 1 and January 8 was sent to Fall River where he is apparently to pay \$1.50 a day until he can get into a State sanatorium. On this same Attleboro card of John Jones's will be placed information, as follows: —

ATTLEBORO, January 1, 1915.

Pul. Tb. — Jones, John

200 Meredith Street.

Also reported to Fall River board of health, January 8, 1915, from City Hospital.

Application made by Dr. James Smith, Attleboro Dispensary, January 9, 1915.

If, upon looking in the index, we do not find the name of John Jones of Attleboro, a pink card will be used to index this application, viz., name of person, city or town, address, application made by whom. This would show that the first knowledge of the case came through the application made to the Massachusetts Trustees of Hospitals for Consumptives.

JONES, John

ATTLEBORO

200 Meredith Street.

Application made by Dr. James Smith, Attleboro Dispensary, January 9, 1915.

Again, through an arrangement between the Massachusetts Trustees of Hospitals for Consumptives, admission notices of people making application to the State sanatoria are forwarded by the superintendents of the various State sanatoria to the State Department of Health. These come in the form of letters of weekly reports. When these are received the files are consulted to see if the names appear in our index. If they do, additional information is placed on the cards bearing whatever information we already have. For instance, John Jones may have been admitted to Lakeville, March 19, 1915. We consult the files and find that John Jones was reported to the local board of health on Jan. 1, 1915; application was made for admission to one of the State sanatoria on Jan. 9, 1915, and we now add the information that John Jones was admitted to the Lakeville Sanatorium on March 19 a moderately advanced case, viz.:—

ATTLEBORO, January 1, 1915.

Pul. Tb. — Jones, John

200 Meredith Street.

Also reported to Fall River board of health, January 8, 1915, from City Hospital.

Application made by Dr. James Smith, Attleboro Dispensary, January 9, 1915.

Lakeville S. S. Admitted March 19, 1915, moderately advanced.

If the information comes in the form of a letter, after the information is recorded in the office of the State Department of Health, the letter is forwarded to the State District Health Officer of the district, including the town or city where the patient in question lives. If the information came through the weekly report, it is assumed that a letter went to the State District Health Officer direct from the sanatorium, and the weekly report is placed on file. If a first knowledge of a case comes through an admission notice, a white card is used. For instance, if we had never heard of John Jones until the admission notice came to the office the information would be recorded on a white card, as follows:—

JONES, John

ATTLEBORO

200 Meredith Street

Lakeville S. S. Admitted March 19, 1915, moderately advanced.

Likewise, as in the admission notice, when a discharge notice is received the files are consulted. And if we find that John Jones has been discharged from Lakeville on June 26, we add this information to that already recorded, and also record the condition on discharge, and any recommendation which may be made by the superintendent of Lakeville; also if the information came in the form of a letter it is forwarded to the State District Health Officer as the admission notice was. This enables the State District Health Officer to have a knowledge of sick consumptives leaving and returning to towns under their jurisdiction. The following card shows information revealed at discharge: —

ATTLEBORO, January 1, 1915.

Pul. Tb. — Jones, John

200 Meredith Street.

Also reported to Fall River board of health, January 8, 1915.

Application made by Dr. James Smith, Attleboro Dispensary,
January 9, 1915.

Lakeville S. S. Admitted March 19, 1915, moderately advanced.

Discharged June 26, 1915, "improved."

Recommended that he shall report to the dispensary or a physician
from time to time.

If a first knowledge of the case comes through discharge from a sanatorium a white card is used.

JONES, John

ATTLEBORO

200 Meredith Street.

Lakeville S. S. Admitted March 19, 1915, moderately advanced.

Discharged June 26, 1915, "improved."

Recommended that he shall report to the dispensary or a physician from time to time.

When an inquiry is made through some social service department of a hospital in the form of a letter, or if any one else writes about a case, even the patient himself, the index is consulted, and if the person's name is found in the index, additional information contained in the letter will be added, and if not, a white card will be used to record data in regard to the person in question, giving name, address and any additional data in the letter. Or we may have information on record which the writer of a letter would like to have, in which instance the same can be forwarded.

C. — When it is learned that a case has died from tuberculosis the date of death is recorded, and card is transferred to the death section of the file. The following letter was sent to the various boards of health in the State, which is self-explanatory: —

As a step forward in rendering a service in the scope of tuberculosis work in this State, we solicit your co-operation to the extent of asking you to kindly send to this office quarterly (in March, June, September and December) a list of names and addresses of persons dying from tuberculosis, in order that we may check off the same from our list of cases.

We would, therefore, appreciate receiving from you forthwith a list of the deaths occurring from all forms of tuberculosis within your town for the period Jan. 1, 1915, to March 31, inclusive, to be followed by others at the stated intervals suggested.

It sometimes happens that on the report made to the local board of health the following statement appears: "Not reported until after death." In this case we do not make the report on a green card, but use a brown card, which shows that first knowledge of the case came through a death report.

As the quarterly lists are received, the deaths are checked off with cases, and if there is no case on record, a brown card is used to record

the death, with particulars, as given on the list received from the local authority. The following card illustrates: —

HOWE, John

ATTLEBORO

169 Cedar Street.

Died from pulmonary tuberculosis, January 17, 1915.

D. — Each week the bacteriologist sends to the office a list of names of positive sputum examinations for the week, and these positive examinations are checked with the cases, and if they are not found in the index, the name is jotted down as a memorandum for reference in case the case is subsequently reported. If the names are found in the index, the information given on the weekly list is recorded.

E. — The names and addresses of aliens arriving at the ports of entry, manifesting destinations within the State of Massachusetts, and afflicted with defects that would indicate a disposition to tuberculosis, are indexed on a yellow card, and filed according to city and town and alphabetically, viz.: —

AVELBRODES, John

NEW BEDFORD.

Phillips Street.

S.S. "St. Paul" October 25, 1915.

to son

Poor physical development.

II. A supply of green cards like the following is furnished each State District Health Officer: —

STATE DEPARTMENT OF HEALTH.

_____: Ill with tuberculosis
 (Town) Form of disease, _____
 Reported, _____ (to local board)
 (Date)
 Name of patient, Residence,
 Birthplace, Nationality,
 How long in U. S., In this town,
 S. M. W. Sex Age
 Where is the patient at this date,
 Occupation: at present, ; when illness began,
 If not working how does patient spend time,
 Home sanitation,
 Personal hygiene (including care of sputum),
 Occupation sanitation,

[REVERSE SIDE.]

How long ill,
 Has patient ever been to a State sanatorium or tb. hospital,
 If so, when and where,
 Condition of other members of household,
 Anything to suggest cause of disease or source of infection,
 What immediate help, if any, should patient have,
 Under what supervision is the patient,
 Remarks (including briefly, family history and personal history),

He distributes these to dispensaries in towns of 10,000 inhabitants or over, and the dispensary clerks or nurses fill them out and forward them to the State District Health Officer, who in turn sends them to the State Department of Health. In special cases the State District Health Officer gets the information direct. When these detailed investigation cards are received at the office of the State Department of Health they are checked with the index and placed on file as the

set card so called. In other words, the object is to centralize all data received in regard to one person on one card. For instance, if a detailed report of John Jones is received on the special printed card, we refer to the information which we have on file, and check it with that contained on the printed card and destroy the card on file, and put in its place this detailed investigation card.

STATE DEPARTMENT OF HEALTH.	
JULY 1, 1915.	
<u>Attleboro</u> (Town)	: ill with tuberculosis Form of disease, <u>pulmonary</u>
Reported, <u>January 1, 1915</u> (to local board) (Date)	
Name of patient, Jones, John	Residence, 200 Meredith St.
Birthplace, Attleboro	Nationality, American
How long in U. S., 30 years	In this town, 30 years
S. M. W. Single	Sex Male Age 30
Where is the patient at this date, At home	
Occupation: at present, None; when illness began, sawing pearl shell	
If not working how does patient spend time, Working in the garden	
Home sanitation, good	
Personal hygiene (including care of sputum), Good care of sputum; uses sputum cup and burns same	
Occupation sanitation, dusty process	

[REVERSE SIDE.]

How long ill, About two years
Has patient ever been to a State sanatorium or tb. hospital, Yes
If so, when and where, From January 8 to March 19 in hospital in Fall River. Lakeville S.S. from March 19, 1915, (admitted as moderately advanced case) to June 26, 1915, discharged as "improved," but should be watched
Condition of other members of household, Well
Anything to suggest cause of disease or source of infection, Occupation
What immediate help, if any, should patient have, None
Under what supervision is the patient, Dispensary
Remarks: (including briefly, family history and personal history), Negative for tuberculosis
<u>State Health District Officer</u>

The inspection of dispensaries and hospitals is made in accordance with chapters 408 and 647 of the Acts of 1914. The following information is obtained during dispensary inspection: —

1. Number of individuals examined (counting one person but once) from July 1 to Dec. 31, 1915, ...
2. How many of the above individuals were not tubercular?
3. Number of living cases (counting one person but once) under active supervision of the dispensary from July 1 to Dec. 31, 1915, ...
 - (a) Pulmonary Tb.
 - (b) Other forms Tb.
4. Total living cases (counting one person but once) reported to local board of health not under supervision of the dispensary July 1 to Dec. 31, 1915, ...
5. Number of cases in State sanatoria (Dec. 31, 1915), ...
6. Number of cases in local hospitals (Dec. 31, 1915), ...
7. Number of deaths from tuberculosis of those under active supervision of dispensary from July 1 to Dec. 31, 1915, ...
8. Number of deaths from tuberculosis in town or city from July 1 to Dec. 3, 1915, ...

III. The State District Health Officers, on receiving the admission or discharge notices, use their judgment as to the necessary action. Following is a sample discharge letter (from Lakeville State Sanatorium): —

This is to inform you that John Jones, admitted March 19, 1915, from 200 Meredith Street, Attleboro, as a "moderately advanced" case, was discharged June 26, 1915, with consent, as an "improved case." Discharged to same address.

His present condition is that of a moderately advanced case of pulmonary tuberculosis, with bilateral involvement. Local and constitutional symptoms are inactive at the present time. Patient improved markedly during residence and gained $9\frac{1}{4}$ pounds in weight.

We believe that this patient should be kept under observation, either at a dispensary or by family physician, and continue treatment.

IV. In towns of less than 10,000 inhabitants first-hand information is obtained through co-operative agencies. For instance, the Massachusetts Trustees of Hospitals for Consumptives are having their field worker investigate cases of tuberculosis for the State Department of Health. When this field worker is about to go into a certain county she notifies the office of the State Department of Health, and a list of names and addresses of patients in the various towns contained therein are forwarded to her. A detailed investigation is made on the printed green card and returned to the office of the State Department of Health. This worker also keeps a copy for her own files. She also notifies the State District Health Officer of the town in ques-

tion in the form of an after-care report of description of patient. The green cards are checked in the office of the State Department of Health as described under II.

V. Each month a report is sent to each State District Health Officer, showing what has been going on in his district during the month so far as tuberculosis is concerned. First, the towns having tuberculosis dispensaries are considered, and secondly, those which have no dispensaries.

Realizing that many cases, which it would appear from our records of this year have never been reported to a local authority, have actually been reported in previous years, and realizing that many cases are not reported until death, the records of a given town are gone over from August, 1907, when tuberculosis in all its forms was made a reportable disease, and a list made of the deaths which have occurred from tuberculosis during the same period of time. The names on the cards are checked with the list of deaths, and the occupation is noted of those who have died. The number of cases reported to the local board of health, thence to State Department of Health, from August, 1907, to date, is given, and also the deaths, in a brief report, and forwarded, accompanied by a letter, to the State District Health Officer of the town in question.

The following letter to a State District Health Officer will give an idea of this constructive work: —

With reference to the inclosed information in regard to the town of —, it is quite apparent that the local physicians have not been reporting all cases of tuberculosis. You will doubtless have an opportunity to confer with the necessary official and stir him to action.

As you will see, out of 49 deaths from tuberculosis (all forms) occurring from August, 1907, to Sept. 30, 1915, 36 were never reported to the State department. And out of the 31 cases reported from August, 1907, to date, there are 18 (13 having died) sick with tuberculosis in — at the present time, unless they have moved away.

You will also find inclosed the names and addresses of the 18 persons sick with tuberculosis, concerning whom we should like to hear sometime in the near future when opportunity presents itself.

The town in question has a population of about 5,000 inhabitants, and patients in question will have to be looked out for in their homes or sent to State sanatoria, unless other hospitalization arrangements can be made with the adjoining communities.

VI. A pamphlet on "Directions for Living and Sleeping in the Open Air" is sent to each patient reported to the local board of health in towns of less than 10,000 inhabitants. A supply of these pamphlets

is available for distribution at the dispensaries in towns of 10,000 inhabitants or over.

Other current literature is sent out from the State Department of Health to dispensaries, local boards of health and State District Health Officers for further distribution under their direction.

The application of this method of procedure will supply all of the fundamentals for the control of tuberculosis. The complete records will furnish an accurate knowledge of the real extent of the problem; the dispensaries, District Health Officers and co-operating agencies will make thorough investigations and attend to adequate follow-up work; and by all of these means the more prompt and complete reporting of cases will be stimulated. Further, by co-operation with the immigration officials any aliens with a suspicious history will be carefully traced. By means of our record system the District Health Officers will see that they do not become State charges. This will often save considerable expense for the Commonwealth.

*Pulmonary Tuberculosis.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	3,101	100.4	148.4 ⁵	4,608	149.1
1907, ...	3,162,187	4,542	143.6	105.1 ⁵	4,771	150.6
1908, ...	3,235,344	5,939	183.6	74.9	4,445	137.4
1909, ...	3,308,501	7,482	244.7	54.4	4,393	132.7
1909, ⁶	-	613	- ⁷	- ⁷	-	-
1910, ...	3,380,037	7,862	232.6	57.3	4,503	133.1
1911, ...	3,445,416	7,031	204.1	62.8	4,418	128.0
1912, ...	3,510,795	7,519	214.2	56.0	4,212	119.9
1913, ...	3,576,174	7,424	207.6	56.4	4,180	117.0
1914, ...	3,641,553	7,144	196.2	58.4	4,171	114.1
1915, ...	3,706,931	8,046	217.0	52.2	4,194	113.2

¹ Made reportable August, 1907.

² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.

³ From the annual reports of the Massachusetts State Board of Health. The cases through 1909 are for the year November 30 to November 30, after which they are for calendar years January 1 to December 31.

⁴ From the annual registration reports of the Secretary of the Commonwealth.

⁵ Apparent fatality rate.

⁶ December.

⁷ In figuring the case rate and the fatality rate for 1909 the month of December has been added to the year 1909.

Diphtheria.

Seven hundred and twenty-one deaths from diphtheria in Massachusetts in one year is a disgrace. This number of deaths followed a total prevalence of at least 9,282 cases reported to this Department last year. This great fatality from a disease whose cause and modes of transmission are well known indicates either gross ignorance or neglect somewhere. This opinion is confirmed when the means of detection and cure of this disease is furnished free by the Commonwealth. Laboratory tests are available to all, and free antitoxin offers a certain prophylactic and specific cure.

The results of this year's study of diphtheria are interesting. The failure to save a large percentage of the 721 lives that were lost was due to two fundamental things: neglect of sore throats and late recourse to antitoxin. This has been amply demonstrated by the investigation now being conducted by the District Health Officers of all the deaths which occurred in this State during 1914.

The sources of diphtheritic infection have been made more clear. "Carriers," "missed cases," and, more rarely, milk-borne cases, tell the story. The routes by which this infection has traveled have led most frequently through the public schools. Earnest efforts have been made by many of the boards of health and school committees to cut off these routes. The method most commonly used was either the closing of the schools or the taking of large numbers of cultures. The closing of the schools and the taking of cultures, where it was not accompanied by adequate medical inspection of schools, has not been successful in controlling the disease or in making a correct epidemiological diagnosis.

The indications are for a comprehensive plan for fighting this disease. This plan should include the education of the public to the seriousness of all throat infections, particularly in children; the conversion of all practicing physicians to the early use of antitoxin; and the adoption of a complete system of administrative control. This control must include prompt reporting, complete isolation, adequate school inspection and thorough case investigation, all controlled by careful laboratory examination. In order to accomplish this control there must be ample facilities for prompt and frequent examinations of cultures from suspects and cases. Finally, there should be a differentiation of these results by means of virulence tests and the Shick reaction.

*Diphtheria.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	8,305	268.9	8.9	743	24.0
1907, ...	3,162,187	8,962	283.4	8.4	752	23.8
1908, ...	3,235,344	9,108	281.5	8.2	747	23.1
1909, ...	3,308,501	7,702	232.8	9.0	694	21.0
1910, ...	3,380,037	7,390	218.6	9.2	679	20.1
1911, ...	3,445,416	6,998	203.1	8.1	563	16.3
1912, ...	3,510,795	5,433	154.8	8.7	473	13.5
1913, ...	3,576,174	6,741	188.5	9.3	628	17.6
1914, ...	3,641,553	8,080	221.9	8.0	652	17.9
1915, ...	3,706,931	9,282	250.4	7.8	721	19.4

¹ Made reportable August, 1907.² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.³ From the annual reports of the Massachusetts State Board of Health.⁴ From the annual registration reports of the Secretary of the Commonwealth.*Scarlet Fever.*

The control of scarlet fever is one of the most difficult problems. The cause is unknown. The lack of a diagnostic test and the large number of mild or atypical cases lead to imperfect or late reporting. This results in multiple contacts and difficulty in tracing the source of the infection.

The most important single route of infection is the public schools. Experience has demonstrated that the only hope of preventing the spread of this disease lies in adequate medical inspection of schools plus *prompt* and thorough home supervision of cases, suspects and contacts. If this medical inspection of schools includes careful records and close co-operation with the local and State health authorities, there is no doubt that this year's record of 8,613 cases and 182 deaths from scarlet fever can be markedly decreased.

Errata:

For the following diseases the dates made
reportable should be:—

1883

Smallpox

1893

Cerebro-Spinal Meningitis

Diphtheria

Leprosy

Malignant Pustule

Scarlet Fever

Trichinosis

Typhoid Fever

Typhus Fever

*Scarlet Fever.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	5,223	169.1	2.6	135	4.4
1907, ...	3,162,187	7,931	250.8	3.6	285	9.0
1908, ...	3,235,344	7,994	247.1	4.6	369	11.4
1909, ...	3,308,501	7,224	218.3	3.6	259	7.8
1910, ...	3,380,037	7,882	233.2	3.2	254	7.5
1911, ...	3,445,416	6,173	179.1	3.0	184	5.3
1912, ...	3,510,795	5,633	160.4	2.1	118	3.4
1913, ...	3,576,174	8,062	225.4	3.6	293	8.2
1914, ...	3,641,553	11,057	303.7	2.2	246	6.8
1915, ...	3,706,931	8,613	232.3	2.1	182	4.9

¹ Made reportable August, 1907.

² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.

³ From the annual reports of the Massachusetts State Board of Health.

⁴ From the annual registration reports of the Secretary of the Commonwealth.

Typhoid Fever.

There were 2,204 cases and 247 deaths from typhoid fever reported to this Department during 1915. This is a forcible reminder that this disease is still a very live public health problem. Our progress in the control of this infection has been gratifying, but does not compare favorably with progress in European countries.

The cause of this disease is well known. Its sources and routes of infection are well understood. While it is still transmitted by means of water, milk, contact and "carriers," their relative importance has changed. Improved water supplies have reduced the water-borne typhoid, and careful studies have failed to prove the great relative importance of "milk-borne" infection. The two important factors are contact and "carriers." Contact infection can be gradually overcome by the education of individuals; the "carrier" presents a serious problem. The length of time during which these individuals harbor and excrete typhoid bacilli makes safe control almost impossible. One "carrier" discovered in Massachusetts during the year had his original infection forty-five years ago. The studies of Sawyer and others emphasize the futility of accepting one or even two negative cultures as a sign the person is free from the infecting germ. Preventive medicine awaits the researches of clinical and laboratory

workers for a solution of this problem. In the meantime the careful supervision of known carriers, the routine examination of food handlers, and education in personal hygiene offer the most hopeful method of satisfactory control. The general problem of the prevention of typhoid fever is still a pressing one. It demands continuous efforts and eternal vigilance upon the part of all health agencies. The water supplies must be guarded; the milk supply safeguarded; the public educated to the general use of the typhoid prophylactic; and correct habits of personal hygiene made a part of everyday life.

*Typhoid Fever.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	2,986	96.6	15.9	477	15.4
1907, ...	3,162,187	2,290	72.5	17.0	389	12.3
1908, ...	3,235,344	3,736	115.5	13.8	517	16.0
1909, ...	3,308,501	2,743	82.9	14.2	390	11.8
1910, ...	3,380,037	3,452	102.1	11.9	411	12.2
1911, ...	3,445,416	2,238	65.0	13.5	302	8.8
1912, ...	3,510,795	2,088	59.5	12.9	269	7.7
1913, ...	3,576,174	2,398	67.0	11.7	280	7.8
1914, ...	3,641,553	2,333	64.1	11.5	268	7.4
1915, ...	3,706,931	2,204	59.5	11.2	247	6.7

¹ Made reportable August, 1907.

² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.

³ From the annual reports of the Massachusetts State Board of Health.

⁴ From the annual registration reports of the Secretary of the Commonwealth.

Measles.

Measles is a *dangerous* disease. It caused at least 149 deaths in Massachusetts last year. Of greater importance, it prepared the soil for numerous cases of tuberculosis and certain other diseases, all of which are more fatal. These facts cannot be repeated too frequently, for until the public is convinced of the truth of these statements there is no hope of controlling this disease.

The infection is extremely difficult to control under ideal conditions. Rosenau says this is true for the reason that "the disease is one of the most highly communicable of all infections, and is most contagious during the pre-eruptive stage."

The source of the infection is, practically, always contact. The route by which this infection travels is by means of the discharges from the nose and throat of an acute case. Aerial transmission and transmission by fomites are unimportant. With these facts understood, and the high-grade susceptibility of children considered, it becomes clear why the public schools are the stamping grounds of this disease.

Previous failures to successfully control measles do not justify inaction. A carefully planned and executed procedure will undoubtedly materially control this disease. This procedure necessitates close co-operation between the public, the local health authorities, the school committee and the practicing physician. It must include sufficient medical inspectors and school nurses plus temporary administrative control of the schools. Where these elements have been furnished, and the machinery has been put into operation *promptly* and *vigorously*, the results have amply repaid the time and money expended.

Many health officials believe that it is useless to attempt to control measles. This is a mistaken point of view. Even controlling the disease to the extent of preventing the infection of young children is worth while, for the disease is most fatal when the victims are under five years of age. The control of measles is an important problem requiring unusual co-operation by all public health agencies.

Measles.¹

YEAR.	Population. ²	Cases. ³	Case Rate per 100,000 Population.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Population.
1906, ...	3,089,030	15,553	503.5	1.3	208	6.7
1907, ...	3,162,187	6,487	205.1	2.5	163	5.2
1908, ...	3,235,344	21,470	663.6	1.5	331	10.2
1909, ...	3,308,501	15,060	455.2	1.0	157	4.7
1910, ...	3,380,037	18,794	556.0	1.3	240	7.1
1911, ...	3,445,416	16,094	467.1	1.0	158	4.6
1912, ...	3,510,795	22,423	638.7	1.3	286	8.2
1913, ...	3,576,174	29,192	816.3	1.1	315	8.8
1914, ...	3,641,553	12,264	336.8	1.2	149	4.1
1915, ...	3,706,931	22,881	617.2	.6	149	4.0

¹ Made reportable August, 1907.

² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.

³ From the annual reports of the Massachusetts State Board of Health.

⁴ From the annual registration reports of the Secretary of the Commonwealth.

Epidemic Cerebro-spinal Meningitis.

This disease attracts attention because of its high fatality rather than its frequency. The records of this Department for 1915 show 145 cases reported, with 125 deaths. A close study of these returns indicates that many of these cases are not true epidemic cerebro-spinal meningitis. The District Health Officers find the diagnosis is infrequently confirmed by bacteriological examination, while the history frequently reveals the fact that the meningitis occurs during the course of pneumonia or tuberculosis. This renders the diagnosis of true epidemic cerebro-spinal meningitis very doubtful. This disease should be carefully studied, for it may become epidemic at any time. In the meantime there should be a more general use of the Flexner anti-meningitis serum.

Cerebro-Spinal Meningitis.¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	298	9.6	123.5 ⁵	368	11.9
1907, ...	3,162,187	432	13.7	100.5 ⁵	434	13.7
1908, ...	3,235,344	192	5.9	94.3	181	5.7
1909, ...	3,308,501	133	4.0	93.2	124	3.7
1910, ...	3,380,037	153	4.5	100.0	153	4.5
1911, ...	3,445,416	150	4.4	95.4	143	4.1
1912, ...	3,510,795	202	5.8	68.4	138	3.9
1913, ...	3,576,174	180	5.0	81.7	147	4.1
1914, ...	3,641,553	181	5.0	86.3	156	4.3
1915, ...	3,706,931	145	3.9	86.3	125	3.4

¹ Made reportable August, 1907.² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.³ From the annual reports of the Massachusetts State Board of Health.⁴ From the annual registration reports of the Secretary of the Commonwealth.⁵ Apparent fatality rate.

TABLES OF LESS FREQUENT COMMUNICABLE DISEASES.

The following tables are published, without particular comment, for the diseases that are less frequently a factor in the communicable diseases report: —

*Actinomycosis.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	-	-	-	-	-
1907, ...	3,162,187	1	.03	200.0 ⁵	2	.06
1908, ...	3,235,344	2	.06	50.0	1	.03
1909, ...	3,308,501	1	.03	100.0	1	.03
1909, ⁶	-	-	-.7	-.7	-	-
1910, ...	3,380,037	3	.09	33.3	1	.03
1911, ...	3,445,416	5	.14	-	-	-
1912, ...	3,510,795	1	.03	-	-	-
1913, ...	3,576,174	3	.08	100.0	3	.08
1914, ...	3,641,553	4	.11	50.0	2	.06
1915, ...	3,706,931	8	.22	50.0	4 ⁸	.11

*Anterior Poliomyelitis.*⁹

YEAR.	Popula- tion. ²	Cases. ⁴	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁵	Death Rate per 100,000 Popula- tion.
1910, ...	3,380,037	845	25.0	6.4	54	1.6
1911, ...	3,445,416	232	6.7	15.5	36	1.0
1912, ...	3,510,795	169	4.8	45.0	76	2.2
1913, ...	3,576,174	361	10.1	19.1	69	1.9
1914, ...	3,641,553	151	4.1	29.8	45	1.2
1915, ...	3,706,931	135	3.6	23.7	32	.8

¹ Made reportable August, 1907.² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.³ From the annual reports of the Massachusetts State Board of Health. The cases through 1909 are for the year November 30 to November 30, after which they are for calendar years January 1 to December 31.⁴ From the annual report of the Massachusetts State Board of Health.⁵ Apparent fatality rate.⁶ December.⁷ In figuring the case rate and the fatality rate the month of December, 1909, has been counted in with the year 1909.⁸ From the annual registration reports of the Secretary of the Commonwealth.⁹ Made reportable November, 1909.

*Anthrax.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	—	—	—	3	.10
1907, ...	3,162,187	1	.03	400.0 ⁵	4	.13
1908, ...	3,235,344	5	.15	40.0	2	.06
1909, ...	3,308,501	7	.21	14.3	1	.03
1909, ⁶	—	—	— ⁷	— ⁷	—	—
1910, ...	3,380,037	7	.21	28.6	2	.06
1911, ...	3,445,416	6	.17	33.3	2	.06
1912, ...	3,510,795	11	.31	18.2	2	.06
1913, ...	3,576,174	8	.22	37.5	3	.08
1914, ...	3,641,553	8	.22	12.5	1	.03
1915, ...	3,706,931	11	.30	36.4	4	.11

*Chicken Pox.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	31	1.0	—	—	—
1907, ...	3,162,187	101	3.2	—	—	—
1908, ...	3,235,344	905	28.0	—	—	—
1909, ...	3,308,501	2,201	75.2	—	—	—
1909, ⁶	—	287	— ⁷	—	—	—
1910, ...	3,380,037	2,351	69.6	—	—	—
1911, ...	3,445,416	2,542	73.8	—	—	—
1912, ...	3,510,795	3,574	101.8	—	—	—
1913, ...	3,576,174	3,822	106.9	.05	2	.06
1914, ...	3,641,553	4,896	134.4	.06	3	.08
1915, ...	3,706,931	5,512	149.0	.09	5	.13

¹ Made reportable August, 1907.² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.³ From the annual reports of the Massachusetts State Board of Health. The cases through 1909 are for the year November 30 to November 30, after which they are for calendar years January 1 to December 31.⁴ From the annual registration reports of the Secretary of the Commonwealth.⁵ Apparent fatality rate.⁶ December.⁷ In figuring the case rate and the fatality rate the month of December, 1909, has been counted in with the year 1909.⁸ From the annual reports of the Massachusetts State Board of Health.

Dog Bite¹ and Rabies.²

YEAR.	Popula- tion. ³	Cases of Dog Bite. ⁴	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths from Rabies. ⁵	Death Rate per 100,000 Popula- tion.
1915, ...	3,706,931	174	4.7	2.9	5	.14

Dysentery.¹

YEAR.	Popula- tion. ³	Cases. ⁴	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths.	Death Rate per 100,000 Popula- tion.
1915, ...	3,706,931	239	6.5	—	—	—

German Measles.²

YEAR.	Popula- tion. ³	Cases. ⁴	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁵	Death Rate per 100,000 Popula- tion.
1915, ...	3,706,931	500	13.49	.2	1	.03

Glanders.⁷

YEAR.	Popula- tion. ³	Cases. ⁴	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁵	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	—	—	—	1	.03
1907, ...	3,162,187	—	—	—	1	.03
1908, ...	3,235,344	—	—	—	1	.03
1909, ...	3,308,501	—	—	—	1	.03
1909, ⁶	—	—	—	—	—	—
1910, ...	3,380,037	3	.09	66.7	2	.06
1911, ...	3,445,416	1	.03	100.0	1	.03
1912, ...	3,510,795	—	—	—	—	—
1913, ...	3,576,174	3	.08	66.7	2	.06
1914, ...	3,641,553	3	.08	100.0	3	.08
1915, ...	3,706,931	2	.06	.50	1	.03

¹ Made reportable September, 1914.² Made reportable May, 1914.³ Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.⁴ From the annual reports of the Massachusetts State Board of Health.⁵ From the annual registration reports of the Secretary of the Commonwealth.⁶ Figures not available.⁷ Made reportable August, 1907.⁸ From the annual reports of the Massachusetts State Board of Health. The cases through 1909 are for the year November 30 to November 30, after which they are for calendar years January 1 to December 31.⁹ December.

*Leprosy.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	1	.03	—	—	—
1907, ...	3,162,187	4	.13	25.0	1	.03
1908, ...	3,235,344	1	.03	—	—	—
1909, ...	3,308,501	4	.15	—	—	—
1909, ⁵	—	1	— ⁶	—	—	—
1910, ...	3,380,037	1	.03	—	—	—
1911, ...	3,445,416	2	.06	—	—	—
1912, ...	3,510,795	4	.11	25.0	1	.03
1913, ...	3,576,174	2	.06	50.0	1	.03
1914, ...	3,641,553	1	.03	100.0	1	.03
1915, ...	3,706,931	2	.05	50.0	1	.03

*Malaria.*⁷

YEAR.	Popula- tion. ²	Cases. ⁸	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1915, ...	3,706,931	112	3.0	5.4	6	.16

*Mumps.*⁷

YEAR.	Popula- tion. ²	Cases. ⁸	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1915, ...	3,706,931	2,128	57.4	.5	1	.03

¹ Made reportable August, 1907.² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.³ From the annual reports of the Massachusetts State Board of Health. The cases through 1909 are for the year November 30 to November 30, after which they are for calendar years January 1 to December 31.⁴ From the annual registration reports of the Secretary of the Commonwealth.⁵ December.⁶ In figuring the case rate and the fatality rate the month of December, 1909, has been counted in with the year 1909.⁷ Made reportable September, 1914.⁸ From the annual reports of the Massachusetts State Board of Health.

*Ophthalmia Neonatorum.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1910, ...	3,380,037	361	10.7	—	—	—
1911, ...	3,445,416	1,372	39.8	—	—	—
1912, ...	3,510,795	1,750	49.9	—	—	—
1913, ...	3,576,174	2,304	64.4	.22	5	.14
1914, ...	3,641,553	2,620	72.0	—	—	—
1915, ...	3,706,931	2,894	78.1	—	—	—

*Pellagra.*⁸

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1915, ...	3,706,931	33	.89	78.8	26	.7

*Septic Sore Throat.*⁵

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1915, ...	3,706,931	865	23.4	—6	—6	—6

*Smallpox.*⁷

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	35	1.1	—	—	—
1907, ...	3,162,187	174	5.5	3.4	6	.19
1908, ...	3,235,344	6	.2	50.0	3	.09
1909, ...	3,308,501	21	.6	4.8	1	.03
1910, ...	3,380,037	156	4.6	—	—	—
1911, ...	3,445,416	111	.3	18.2	2	.06
1912, ...	3,510,795	220	6.3	.5	1	.03
1913, ...	3,576,174	157	4.4	—	—	—
1914, ...	3,641,553	38	1.0	—	—	—
1915, ...	3,706,931	24	.6	37.5	9	.24

¹ Made reportable May, 1909.² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.³ From the annual reports of the Massachusetts State Board of Health.⁴ From the annual registration reports of the Secretary of the Commonwealth.⁵ Made reportable September, 1914.⁶ Figures not available.⁷ Made reportable August, 1907.⁸ Made reportable May, 1914.

*Tetanus.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	—	—	—	29	.9
1907, ...	3,162,187	8	.3	387.5 ⁵	31	1.0
1908, ...	3,235,344	12	.4	208.3 ⁵	25	.8
1909, ...	3,308,501	16	.5	187.5 ⁵	30	.9
1909, ⁶	—	1	— ⁷	— ⁷	—	—
1910, ...	3,380,037	36	1.1	100.0	36	1.1
1911, ...	3,445,416	38	1.1	71.1	27	.8
1912, ...	3,510,795	24	.7	112.5 ⁵	27	.8
1913, ...	3,576,174	23	.6	143.5 ⁵	33	.9
1914, ...	3,641,553	31	.9	90.3	28	.8
1915, ...	3,706,931	32	.8	103.0 ⁵	33	.9

*Trachoma.*⁸

YEAR.	Popula- tion. ²	Cases. ⁹	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1910, ...	3,380,037	7	.2	—	—	—
1911, ...	3,445,416	21	.6	—	—	—
1912, ...	3,510,795	46	1.3	—	—	—
1913, ...	3,576,174	112	3.2	—	—	—
1914, ...	3,641,553	68	1.9	—	—	—
1915, ...	3,706,931	50	1.4	—	—	—

¹ Made reportable August, 1907.² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.³ From the annual reports of the Massachusetts State Board of Health. The cases through 1909 are for the year November 30 to November 30, after which they are for calendar years, January 1 to December 31.⁴ From the annual registration reports of the Secretary of the Commonwealth.⁵ Apparent fatality rate.⁶ December.⁷ In figuring the case rate and the fatality rate the month of December, 1909, has been counted in with the year 1909.⁸ Made reportable May, 1909.⁹ From the annual reports of the State Board of Health.

*Trichinosis.*¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	—	—	—	1	.03
1907, ...	3,162,187	7	.22	—	—	—
1908, ...	3,235,344	2	.06	—	—	—
1909, ...	3,308,501	5	.18	—	—	—
1909, ⁵	—	1	— ⁶	— ⁶	—	—
1910, ...	3,380,037	—	—	—	—	—
1911, ...	3,445,416	—	—	—	—	—
1912, ...	3,510,795	10	.28	30.0	3	.09
1913, ...	3,576,174	5	.14	80.0	4	.11
1914, ...	3,641,553	5	.14	60.0	3	.08
1915, ...	3,706,931	—	—	—	— ⁷	—

*Tuberculosis — Other Forms than Pulmonary.*⁸

YEAR.	Popula- tion. ²	Cases. ⁴	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁷	Death Rate per 100,000 Popula- tion.
1912, ...	3,510,795	477	13.6	179.2 ⁹	855	24.4
1913, ...	3,576,174	412	11.4	210.9 ⁹	869	24.1
1914, ...	3,641,553	570	15.7	156.1 ⁹	890	24.7
1915, ...	3,706,931	822	22.2	103.9	853	23.0

*Typhus Fever.*¹

YEAR.	Popula- tion. ²	Cases. ⁴	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁷	Death Rate per 100,000 Popula- tion.
1913, ...	3,576,174	2	.06	50.0	1	.03
1914, ...	3,641,553	5	.14	20.0	1	.03
1915, ...	3,706,931	—	—	—	—	—

¹ Made reportable August, 1907.² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.³ From the annual reports of the Massachusetts State Board of Health. The cases through 1909 are for the year November 30 to November 30, after which they are for calendar years January 1 to December 31.⁴ From the annual reports of the Massachusetts State Board of Health.⁵ December.⁶ In figuring the case rate and the fatality rate the month of December, 1909, has been counted in with the year 1909.⁷ From the annual registration reports of the Secretary of the Commonwealth.⁸ Made reportable August, 1907. Reports previous to 1912 very incomplete.⁹ Apparent fatality rate.

Whooping Cough.¹

YEAR.	Popula- tion. ²	Cases. ³	Case Rate per 100,000 Popula- tion.	Fatality Rate.	Deaths. ⁴	Death Rate per 100,000 Popula- tion.
1906, ...	3,089,030	52	1.7	978.8 ⁵	509	16.5
1907, ...	3,162,187	230	7.3	105.6 ⁵	243	7.7
1908, ...	3,235,344	1,134	35.0	25.4	288	8.9
1909, ...	3,308,501	2,161	67.8	11.6	250	7.6
1909, ⁶	—	81	— ⁷	— ⁷	—	—
1910, ...	3,380,037	1,436	42.5	12.7	183	5.4
1911, ...	3,445,416	3,911	113.5	7.5	292	8.5
1912, ...	3,510,795	3,112	88.6	7.2	225	6.4
1913, ...	3,576,174	3,325	93.0	7.2	239	6.8
1914, ...	3,641,553	3,316	91.1	6.8	225	6.2
1915, ...	3,706,931	7,182	193.7	3.9	283	7.6

¹ Made reportable August, 1907.

² Populations estimated arithmetically as of July 1 from the 1910 Federal Census and the 1915 State Census.

³ From the annual reports of the Massachusetts State Board of Health. The cases through 1909 are for the year November 30 to November 30, after which they are for calendar years January 1 to December 31.

⁴ From the annual registration reports of the Secretary of the Commonwealth.

⁵ Apparent fatality rate.

⁶ December.

⁷ In figuring the case rate and the fatality rate for 1909 the month of December has been added to the year 1909.

EPIDEMIOLOGICAL SUMMARIES.

The following summaries are appended to show the character and mode of the investigations, as well as the sources and modes of infection. They are selected as examples to illustrate the various types of outbreaks.

TYPHOID FEVER, EAST DEERFIELD YARDS, BOSTON & MAINE RAILROAD, NEAR GREENFIELD, OCTOBER, 1914, TO FEBRUARY, 1915.

By John S. Hitchcock, State District Health Officer.

Mode of transmission: Water.

Initiated by District Health Officer.

Reason: Continued reporting of typhoid cases at frequent intervals.

History: From Oct. 6, 1914, to Feb. 11, 1915, 17 cases of typhoid fever were reported, all of whom had frequented the East Deerfield Terminal of the Boston & Maine Railroad, about 3 miles from Greenfield. The majority of these cases occurred in railway employees who frequented a Y. M. C. A. maintained at this point for the convenience and recreation of the men.

D. H. O.'s investigation: A study of the occupation, residence and history of the reported cases revealed several important things. Most of them were railroad employees whose homes were in various parts of the State, and who only came to Greenfield at intervals. Further study showed that they had no common milk or food supply. The only common factor in their lives was the use of the water at the East Deerfield Terminal shops, roundhouse and Y. M. C. A. The drinking water at the Y. M. C. A. was piped from hillside spring and filtered. This water, used for washing dishes and bathing, was taken from the tanks used to supply engines with water. Water *ordinarily* used for all purposes in shop and roundhouse is gathered in a small reservoir from an apparently safe watershed. In emergencies the tank water was used for all purposes by means of pipe connection. This tank water is pumped from a point three-quarters of a mile below the junction of the Green and Deerfield rivers. This point is 1 mile below where the main sewer of the town of Greenfield empties into the river.

In consequence of a particularly dry summer (1914) the water supply was short and the Deerfield River very low, and consisted practically of unfiltered sewage. Tank water was turned in and used at the Y. M. C. A. building.

Further investigation resulted in locating some cases in Greenfield from which the stools had been thrown into the sewer without disinfection.

This outbreak of typhoid fever (17 cases, 2 fatal) was due primarily to placing undisinfected typhoid stools in the sewers with a consequent pollution of the water supply of the East Deerfield Terminal.

TYPHOID FEVER, CHELMSFORD, JANUARY, 1915.

By Charles E. Simpson, State District Health Officer.

Mode of transmission: Water.

Initiated by District Health Officer.

Reason: Occurrence of 4 cases within two weeks.

History: four cases of typhoid fever were reported within a short time. Three cases live in North Chelmsford and one in West Chelmsford. All of them work in the North Chelmsford Mills but one in a separate factory. No close contact. No two had the same milkman. The only common factor was the water supply.

D. H. O.'s investigation: water supply, Mill No. 1 (3 cases), town water in pails with common dipper; Mill No. 2 (1 case), town water or Adam's well (polluted). For mechanical purposes these mills use water from a canal leading from Crystal Lake. About two weeks previous to the first case about 200 ice cutters worked on Crystal Lake near the head of the canal. There were no adequate toilet facilities and every likelihood that the canal became polluted by a carrier. The probable route of transfer was by means of the canal water having been used for drinking purposes in the mills.

Results: Engineering Division reported town water of good quality and Adam's well grossly polluted; also the canal water. Attention of local board of health called to these facts and warning of employees advised.

TYPHOID FEVER, NORTHBRIDGE, OCT. 12 TO 25, 1915.

By Wm. W. Walcott, State District Health Officer.

Mode of transmission: Milk.

Initiated by District Health Officer.

Reason: Sudden increase in reported cases.

History: During period October 12-30, 18 cases of typhoid fever were reported from the village of Rochdale (2,000 inhabitants). The cases were limited to this one part of Northbridge. The distribution and sharpness of onsets indicated either milk or water-borne infection. The town is supplied by five dairymen. The water supply is municipal, and is taken from driven wells.

D. H. O.'s investigation: Investigation of all the dairies sending milk into Rochdale resulted in locating at the milk farm a son of the proprietor with a positive widal. He had been ill with a diagnosis of malaria. At the time of the investigation he was attending to his duties. All of the milk produced at this farm went to Rochdale. The other dairies were negative. Checking of cases showed that every one of the cases, directly or indirectly, were supplied with milk from this farm. Water supply is taken from five tubular wells driven about 250 feet from the Blackstone River. Water is pumped to a reservoir. There is a check valve that connects the village supply with the Blackstone River for fire purposes. A fire occurred on September 27, in the district where most of the typhoid cases were located. From 11 to 12 A.M. the Blackstone River water was pumped through the mains.

Results: Milk supply properly supervised and milk handler with positive Widal prohibited from handling milk. Attention of the town called to the danger of using polluted water through service mains even for fire purposes.

TYPHOID FEVER, QUINCY, NOVEMBER, 1915.

By Merrill E. Champion, State District Health Officer.

Mode of transmission: Apparently a milk-borne infection.

Initiated by District Health Officer.

Reason: Unusual number of cases.

History: Three cases of typhoid were reported November 11, — a mother and two children. The mother had been sick eighteen days, one child twelve days, and the other eight days before being reported as typhoid. The milk supply was at first given as that of Mr. W. solely. The latter is a distributor only, getting his supply from two Braintree producers. Later it was found that milk was had from Mr. S. as well, a small producer of Quincy. The next case got milk from Mr. W. and Mr. S.; the next from Mr. R. and Mr. S.; another from Mr. S. alone; the next from Mr. W. and Mr. S. Of the next 3 cases, 1 was said to have had some milk from Mr. S. (denied by the latter); another had a pasteurized supply; and a third — a foreigner — could or would give no information as to his milk supply. Thus it will be seen that of 10 cases, 5 got their milk from Mr. S. and Mr. W.; 1 of Mr. S. and Mr. R.; 1 of Mr. S. alone; 1 who may have had milk from Mr. S.; 1 in doubt; and 1 an entirely different supply.

D. H. O.'s investigation: Investigation was started first with Mr. W. before it was known the part Mr. S. played. So far as we got, nothing suspicious was found. When it was learned that 7 cases had milk of Mr. S. who had only a small route (25), attention was at once turned to him. We found that he had a small insanitary stable, used his kitchen as a milk room, used no ice, and lastly, was operating without a permit from the board of health. Only two handled the milk, — mother and son. Widal's were taken from both; the mother's was reported positive.

Results: Mr. S. was forbidden by the local board to sell milk, pending arrangements for raising the standard of his equipment and for eliminating the mother as a food handler. No further cases have occurred since that time (November 13) which did not date back to an earlier period.

TYPHOID FEVER, GRAFTON STATE INSANE HOSPITAL, MAY, 1915.

By Wm. W. Walcott, State District Health Officer.

Mode of transmission: typhoid "carrier."

Initiated by District Health Officer.

Reason: Two positive Widal's from hospital (population: 1,469 patients, 369 employees).

History: Twenty-one cases were reported in the following order: —

May 8,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
May 15,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
May 17,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
May 19,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7
May 24,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7
																				—
																				21

Milk supply from B. and N. of North Grafton, and some milk produced at the institution. Investigations of these supplies proved negative. Water was found to be all right. Widal's of employees and patients who handled foods resulted in finding three positives: No. 1, W. N., milker at O Farm; no history of any suggestive illness. No. 2, M. W., patient, handles food; no suggestion of any typhoid in past history. No. 3, B. M., food handler; typhoid fever, 1905.

Typhoid bacilli were demonstrated in feces of B. M.

Results: All employees and patients given antityphoid vaccine. Milk utensils carefully sterilized. M. W. and B. M. excluded from kitchen and kept under observation, and no new patients detailed to food handling unless giving a negative Widal. No further cases have developed.

DIPHTHERIA, ROCKPORT, SEPTEMBER, 1915.

By William H. Coon, State District Health Officer.

Mode of transmission: "Missed" cases.

Initiated by District Health Officer.

Reason: Unusual number of cases.

History: Five cases reported in three days. Five more cases followed.

No. 1, A. G., September 21.

No. 2, C. G., September 21.

No. 3, Mrs. J. W., September 23.

No. 4, M. W., September 23.

No. 5, H. R., September 23.

No. 6, D. M., September 28.

No. 7, A. B., September 28.

No. 8, F. N., September 29.

No. 9, B. F., September 29.

No. 10, R. H., September 30.

D. H. O.'s investigation: On September 21 the school physician, in the course of general examination of pupils, excluded F. N. from Mt. Pleasant school with a "patch" on her throat. She was not attended by a physician, and for some days played with other children, among them A. G. and C. G., who in turn became ill. During the early part of their sickness attended school, in this way infecting.

Results: Culture of schools — investigation.

This outbreak shows the usual cycle of unrecognized cases, with a physician called later, the extension of disease by contact infection to others in the immediate neighborhood, and spread through schools. It shows the necessity of follow-up work in children excluded from schools and active co-operation between school physicians and boards of health.

DIPHTHERIA, FRAMINGHAM, SEPT. 6 TO 30, 1915.

By Wm. W. Walcott, State District Health Officer.

Mode of transmission: Contact infection.

Initiated by District Health Officer.

Reason: Unusual number of cases of diphtheria reported.

History: The reports came in the following order: September 6, 2; September 10, 1; September 11, 1; September 18, 11; September 20, 1; September 22, 1; September 25, 6.

D. H. O.'s investigation: The cases were all in one neighborhood and a short distance from the Dennison factory. Some cases were employed in factory, and home work was carried on in the homes. The children all attended one school. No common milk supply. There was a clear history of contact in all of the cases.

Results: Mr. R. N. Hoyt, agent of local board of health, in conjunction with Dr. Healy, the school physician, handled the situation. All school children in the district and every suspicious case cultured. Other suspicious contacts were also cultured. As a result three carriers were found and isolated in one house. By co-operation with Dennison Manufacturing Company all tags possibly infected were destroyed, and employees with diphtheria in the family were required to present a certificate of negative nose and throat culture before returning to work. Quarantine supervised, antitoxin freely administered, and good follow-up cultures. Outbreak controlled.

DIPHtheria, MARLBOROUGH, NOV. 5, 1915.

By Wm. W. Walcott, State District Health Officer.

Mode of transmission: Concealed case.

Initiated by District Health Officer.

Reason: Report from local board of health that a case of diphtheria had been removed from a local boarding school to her home.

History: On November 1 child taken ill at the school with sore throat and malaise. Confined to room part of the time and part of time mingled with other children. Physician called and child removed to home without having throat examination made by house physician. Attending physician at home sent child to Newton Hospital at once.

D. H. O.'s investigation: Found the school had about 100 boarding pupils and 40 day pupils, besides sisters who teach in the academy and the parochial schools. The head of the school claimed that she had no knowledge that the child had diphtheria, and that she did not understand about quarantine, isolation, etc. Eight additional cases developed.

Results: Institution quarantined. Isolation established in a cottage on the grounds. Cultures taken from all pupils and teachers. Regulation passed by local board of health prohibiting the removal of any sick child from the academy without examination and permit by board of health.

DIPHtheria, HOLBROOK AND BROCKTON, SEPT. 1 TO 13, 1915.

By Merrill E. Champion, State District Health Officer.

Mode of transmission: Milk.

Initiated by District Health Officer.

Reason: Report of Health Officer of Brockton of discovery of diphtheria carriers on milk farm.

History: The reporting of three cases of diphtheria in one family in Brockton led to an investigation by the Brockton board of health of the source of milk supply. It resulted in finding four positive cultures on the milk farm of B. in Holbrook. This included the man who did the milking. Brockton promptly notified this office by telephone, and stopped the sale of milk in Brockton and advised the Holbrook board of health.

D. H. O.'s investigation: The investigation of the farm of B. at Holbrook revealed four persons with diphtheria bacilli in their throat. The infection was probably introduced by a member of the family who returned from a vacation in Nantucket with a sore throat to which no attention was given. The customers of this dairy in Holbrook were visited by the District Health Officer, while those in Brockton were handled by the Brockton Health Officer. Of the 32 cases of sore throat in Holbrook, 30 were on B's milk route and 16 gave positive cultures for diphtheria. Brockton added 11 cases to this list. All cases mild.

Results: Milk from B's farm excluded from market at once. Family quarantined. Outbreak checked.

COMMUNICABLE DISEASE STATISTICS.

A General Review of the Vital Statistics of the State, 1915.

Many of the comments and tables published in former reports under the above title have been omitted in this report. This has been done because of a change in the method of tabulating death returns by the State registrar in order to make a clear and more accurate presentation of the vital returns. Through the hearty co-operation of the Secretary of the Commonwealth, through his deputy, Herbert H. Boynton, the complete death returns of each city and town are now being furnished to this Department monthly instead of annually. This makes possible the publication of complete tables of cases and deaths from various diseases in the monthly public health bulletin. These tables are proving of great value to the public health officials. However, this change in method will necessitate some delay in the tabulating of death returns of 1915. Thereafter it will make the death returns available earlier.

For clearness of presentation the discussion and tables bearing upon individual diseases will be found in the report of the epidemiologist.

The geographic distribution and seasonal incidence of diseases has been retained in this section.

Massachusetts.

YEARS.	Population.	Deaths.	Death Rates.	YEARS.	Population.	Deaths.	Death Rates.
1906, . .	3,044,998	50,624	16.63	1911, . .	3,444,059	53,062	15.42
1907, . .	3,086,885	54,234	17.57	1912, . .	3,523,493	52,400	14.87
1908, . .	3,129,348	51,788	16.55	1913, . .	3,604,759	53,402	14.81
1909, . .	3,172,395	51,236	16.16	1914, . .	3,594,266	52,978	14.74
1910, . .	3,366,416	54,407	16.16	1915, . .	3,693,310	53,127	14.38

Cases of Communicable Diseases reported to the Massachusetts State Department of Health during 1915.

CITIES AND TOWNS ALPHABETICALLY AR- RANGED.	Population taken by the State as of 1915.	Actinomycosis.	Anterior Polymy- elitis.	Anthrax.	Cerebrospinal Men- ingitis.	Chicken Pox.	Diphtheria.	Dog Bite.	Dysentery.	German Measles.	Glanders.	Leprosy.	Malaria.	Measles.	Mumps.	Ophthalmia.	Pellagra.	Rabies.	Scarlet Fever.	Septic Sore Throat.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmo- nary.	Tuberculosis, Other.	Typhoid Fever.	Whooping Cough.
Massachusetts, .	3,683,310	8	135	11	145	5,512	9,282	174	239	500	2	2	112	22,881	2,128	2,894	33	5	8,613	865	24	32	50	-	8,046	822	2,204	7,182
Abington, .	5,646	-	-	-	-	11	-	-	-	-	-	-	-	4	2	-	-	-	10	-	-	-	-	-	3	-	1	9
Acton, .	2,151	-	-	-	-	-	4	-	-	-	-	-	-	3	1	-	-	-	2	-	-	1	-	-	6	-	1	1
Acushnet, .	2,387	-	-	-	-	1	-	-	-	-	-	-	-	6	9	2	-	-	14	-	-	-	-	-	1	-	1	-
Adams, .	13,218	-	-	-	-	2	16	-	-	-	-	-	-	1	1	2	-	-	18	4	-	-	-	-	12	2	17	-
Agawam, .	4,555	-	-	-	-	2	11	-	-	-	-	-	-	4	-	-	-	-	2	-	-	-	-	-	-	-	1	-
Alford, .	271	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Amesbury, .	8,543	-	-	-	-	3	2	-	-	-	-	-	-	9	-	1	-	-	30	-	-	-	-	-	6	-	5	-
Amherst, .	5,558	-	2	-	-	32	38	-	-	-	-	-	-	11	-	1	-	-	4	1	-	-	-	-	7	-	2	31
Andover, .	7,978	-	-	-	3	40	27	-	-	111	-	-	-	54	5	2	-	-	41	-	-	-	-	-	19	1	1	12
Arlington, .	14,889	-	-	-	1	2	10	4	-	-	-	-	-	10	1	1	-	-	50	-	-	-	-	-	12	-	4	6
Ashburnham, .	2,059	-	-	-	-	-	3	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	22	-
Ashby, .	922	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
Ashfield, .	994	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Ashland, .	2,005	-	1	-	-	11	-	-	-	-	-	-	-	23	1	2	-	-	4	-	-	-	-	-	1	-	1	9
Athol, .	9,783	-	-	-	-	1	2	-	-	-	-	-	-	3	-	1	-	-	17	-	-	-	-	-	9	-	3	10
Attleboro, .	18,480	-	1	-	-	35	39	13	-	4	-	-	-	15	58	2	-	-	36	1	-	-	-	-	34	1	10	43

Chelsea, . . .	43,426	-	-	-	3	71	70	3	2	1	-	-	1	462	6	41	1	-	81	2	-	2	3	-	115	13	36	93
Cheshire, . . .	1,535	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	
Chester, . . .	1,344	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	
Chesterfield, . . .	559	-	-	-	-	-	7	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	4	
Chicopee, . . .	30,138	-	2	-	1	8	51	-	-	15	-	-	2	56	24	11	-	-	39	4	-	1	-	-	76	1	26	17
Chilmark, . . .	288	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
Clarksburg, . . .	1,114	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	
Clinton, . . .	13,192	-	-	-	-	22	10	-	-	1	-	-	1	12	10	3	-	-	18	4	-	-	-	-	33	7	8	5
Colhasset, . . .	2,800	-	-	-	-	30	-	-	-	-	-	-	-	5	1	1	-	-	6	-	-	-	-	-	-	-	7	
Colrain, . . .	1,829	-	-	-	-	1	-	-	-	-	-	-	-	1	-	1	-	-	1	-	-	-	-	-	2	-	-	-
Concord, . . .	6,681	-	-	-	-	10	3	-	-	-	-	-	-	98	1	-	-	-	7	-	-	-	-	-	9	4	2	75
Conway, ¹ . . .	1,220	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cummington, . . .	660	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	4	
Dalton, . . .	3,858	-	-	-	-	-	-	-	-	-	-	-	-	22	5	1	-	-	4	-	-	-	-	-	3	-	-	-
Dana, . . .	712	-	-	-	-	3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Danvers, . . .	11,177	-	-	-	-	76	40	-	-	-	-	-	-	17	4	3	1	-	12	-	-	-	-	-	23	1	1	55
Dartmouth, . . .	5,330	-	-	-	-	2	8	-	-	-	-	-	-	15	1	2	-	-	16	-	-	-	-	-	4	1	2	6
Dedham, . . .	11,043	-	1	-	-	6	19	-	-	-	-	-	1	63	13	1	-	-	31	1	-	-	-	-	15	2	2	4
Deerfield, . . .	2,739	-	-	-	-	3	1	-	-	-	-	-	-	-	3	1	-	-	9	-	-	-	-	-	1	-	-	3
Dennis, . . .	1,822	-	-	-	-	-	1	-	-	-	-	-	-	8	-	1	-	-	-	-	-	-	-	-	1	-	2	3
Dighton, . . .	2,499	-	-	-	-	-	3	-	-	-	-	-	-	8	-	-	-	-	1	-	-	-	-	-	1	-	3	-
Douglas, . . .	2,170	-	-	-	-	6	-	-	-	-	-	-	7	-	1	2	-	-	1	-	-	1	-	-	3	1	-	6
Dover, ¹ . . .	993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

¹ No report.

Cases of Communicable Diseases reported to the Massachusetts State Department of Health during 1915 — Continued.

CITIES AND TOWNS ALPHABETICALLY AR- RANGED.	Population taken by the State as of 1915.	Actinomycosis.	Anterior Poliomye- litis.	Anthrax.	Cerebrospinal Men- ingitis.	Chicken Pox.	Diphtheria.	Dog Bite.	Dysentery.	German Measles.	Glanders.	Leprosy.	Malaria.	Measles.	Mumps.	Ophthalmia.	Pellagra.	Rabies.	Scarlet Fever.	Septic Sore Throat.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmo- nary.	Tuberculosis, Other.	Typhoid Fever.	Whooping Cough.
Dracut, . . .	4,022	-	-	-	-	-	3	-	-	-	-	-	-	9	-	3	-	-	4	-	-	-	-	-	1	-	-	-
Dudley, . . .	4,373	-	-	-	-	1	1	-	-	-	-	-	-	7	-	-	-	-	1	-	-	-	-	-	1	-	-	4
Dunstable, . . .	302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Duxbury, . . .	1,921	-	1	-	1	9	2	-	-	-	-	-	-	3	2	1	-	-	-	-	-	-	-	1	-	-	-	1
East Bridgewater, . . .	3,689	-	1	-	-	2	2	-	-	-	-	-	-	5	-	1	-	-	2	-	-	-	-	62	1	1	1	2
East Longmeadow, . . .	1,939	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Eastham, . . .	545	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-
Easthampton, . . .	9,845	-	-	-	-	23	6	-	-	-	-	-	-	71	1	-	-	-	9	-	-	-	-	-	19	1	2	42
Easton, . . .	5,064	-	-	-	-	12	7	-	-	1	-	-	-	2	9	-	-	-	6	1	-	-	-	-	4	-	16	6
Edgartown, . . .	1,276	-	-	-	-	3	25	-	-	-	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	1	-	-
Egremont, . . .	599	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Enfield, . . .	806	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Erving, . . .	1,168	-	-	-	-	2	-	-	-	-	-	-	-	-	3	-	-	-	2	-	-	-	1	-	-	-	-	-
Essex, . . .	1,677	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	6	6
Everett, . . .	37,718	-	1	-	2	43	134	-	-	2	-	-	1	484	13	23	-	-	160	3	-	-	1	-	104	6	17	59
Fairhaven, . . .	6,277	-	-	-	-	5	3	-	-	-	-	-	-	6	-	3	-	-	4	-	-	-	-	-	9	-	5	8
Fall River, . . .	124,791	-	2	1	8	68	170	2	-	12	-	-	-	358	36	161	-	-	177	13	-	-	-	-	320	45	166	180

Falmouth,	3,917	-	-	-	-	10	3	31	342	3	-	2	-	-	-	-	-	19	5	-	-	-	-	1	-	-	82	18	16	107
Fitchburg,	39,656	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Florida, ¹	427	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Foxborough,	3,755	-	-	-	-	14	-	14	4	-	4	-	-	-	-	-	-	4	1	-	-	-	-	-	-	-	2	-	5	16
Frammingham,	15,860	-	-	-	-	24	-	24	51	-	-	-	-	1	-	-	-	41	45	1	-	-	-	-	-	-	17	-	10	68
Franklin,	6,440	-	-	-	-	10	-	10	1	4	-	1	-	-	-	-	-	73	-	-	-	-	-	-	-	-	5	-	1	-
Freetown,	1,663	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	28	9	-	-	-	-	-	-	1	-	-	-	-
Gardner,	16,376	-	-	-	-	31	-	31	18	-	-	-	-	-	-	-	105	-	5	-	-	-	-	-	-	25	1	12	40	-
Gay Head, ¹	175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Georgetown,	2,058	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-	2	-	-	-	-	-
Gill,	951	-	-	-	-	15	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Gloucester,	24,478	-	-	-	-	7	-	7	9	3	1	-	-	-	-	-	15	-	1	-	-	-	-	-	-	37	1	5	28	-
Goshen,	289	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gosnold,	155	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grafton,	6,250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	21	-	-
Granby,	838	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1	-	-	-	-	-	-	-	-	-	-	-	-
Granville, ¹	784	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Great Barrington,	6,627	-	-	-	-	38	-	-	-	-	-	-	-	-	-	-	184	22	2	-	-	-	-	-	-	8	-	2	21	-
Greenfield,	12,618	-	-	-	-	37	-	37	5	-	-	1	-	-	-	-	5	3	8	1	-	-	-	-	-	17	1	8	20	-
Greenwich,	426	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Groton,	2,333	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Groveland,	2,377	-	-	-	-	-	-	-	5	1	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	1	-	-
Hadley,	2,666	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	1	7	-	-

1 No report.

Cases of Communicable Diseases reported to the Massachusetts State Department of Health during 1915 — Continued.

CITIES AND TOWNS ALPHABETICALLY AR- RANGED.	Population taken by the State as of 1915.	DISEASES.																										
		Actinomycosis.	Anterior Polio-my- elitis.	Anthrax.	Cerebrospinal Men- ingitis.	Chicken Pox.	Diphtheria.	Dog Bite.	Dysentery.	German Measles.	Glanders.	Leprosy.	Malaria.	Measles.	Mumps.	Ophthalmia.	Pellagra.	Rabies.	Scarlet Fever.	Septic Sore Throat.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmo- nary.	Tuberculosis, Other.	Typhoid Fever.	Whooping Cough.
Halifax, . . .	638	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Hamilton, ¹ . . .	1,879	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hampden, ¹ . . .	670	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hancock, ¹ . . .	514	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hanover, . . .	2,666	-	-	-	-	-	2	-	-	-	-	-	-	20	-	-	-	-	1	-	-	-	-	-	1	-	1	-
Hanson, . . .	1,706	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Hardwick, . . .	3,596	-	-	-	1	8	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	4	-	-	-
Harvard, . . .	1,104	-	-	-	-	-	1	-	-	-	-	-	-	3	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Harwich, . . .	2,179	-	-	-	-	1	2	-	-	1	-	-	-	4	-	-	-	-	7	-	-	-	-	-	-	5	-	-
Hatfield, . . .	2,630	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3	3	4	-
Haverhill, . . .	49,450	-	6	-	-	105	222	11	-	16	-	-	1	391	11	28	-	1	208	10	-	-	-	-	117	9	33	30
Hawley, ¹ . . .	427	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heath, ¹ . . .	383	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hingham, . . .	5,264	-	-	-	-	4	1	-	-	-	-	-	-	5	-	-	-	2	-	-	-	-	-	-	3	-	4	4
Hinsdale, . . .	1,257	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Holbrook, . . .	2,948	-	1	-	-	10	19	-	-	1	-	-	-	12	1	-	-	-	4	-	-	-	-	-	3	-	1	-
Holden, . . .	2,514	-	-	-	1	4	3	2	1	-	-	-	-	14	3	-	1	1	1	1	-	-	-	-	7	2	1	29

Cases of Communicable Diseases reported to the Massachusetts State Department of Health during 1915 — Continued.

CITIES AND TOWNS ALPHABETICALLY AR- RANGED.	Population taken by the State as of 1915.	Actinomycosis.	Anterior Poliomye- litis.	Anthrax.	Cerebrospinal Men- ingitis.	Chicken Pox.	Diphtheria.	Dog Bite.	Dysentery.	German Measles.	Glanders.	Leprosy.	Malaria.	Measles.	Mumps.	Ophthalmia.	Pellagra.	Rabies.	Scarlet Fever.	Septic Sore Throat.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmo- nary.	Tuberculosis, Other.	Typhoid Fever.	Whooping Cough.
Littleton, . . .	1,228	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	1	-
Longmeadow, . .	1,782	-	-	-	-	2	1	-	-	-	-	-	-	3	3	-	-	-	1	-	-	-	-	-	-	-	-	1
Lowell, . . .	107,978	-	-	-	6	44	205	14	-	1	-	-	2	165	10	62	3	-	121	2	-	3	3	-	208	2	114	61
Ludlow, . . .	6,251	-	-	-	-	17	1	-	-	2	-	-	-	10	-	4	-	-	4	1	-	-	-	-	1	-	2	20
Lunenburg, . . .	1,610	-	-	-	-	1	-	-	-	-	-	-	-	-	4	-	-	-	1	-	-	-	-	-	6	-	-	67
Lynn, . . .	95,803	-	-	-	2	102	211	1	19	-	-	-	-	351	7	50	-	-	287	2	-	1	1	-	196	23	62	75
Lynnfield, ¹ . . .	1,112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Malden, . . .	48,907	-	-	-	-	14	203	-	3	-	-	-	-	500	-	56	-	-	133	2	-	-	-	-	93	7	26	48
Manchester, . . .	2,945	-	-	-	-	31	1	-	1	-	-	-	-	47	-	-	-	-	1	-	-	-	-	-	4	1	1	-
Mansfield, . . .	5,772	-	-	-	-	9	1	-	6	-	-	-	1	9	4	2	-	-	22	2	-	-	-	-	11	-	46	54
Marblehead, . . .	7,606	-	-	-	-	10	38	-	-	-	-	-	-	7	4	2	-	-	4	1	-	-	-	-	5	-	4	-
Marion, . . .	1,487	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	1	-	-	-	-	-	5	-	-	-
Marlborough, . .	15,250	-	-	-	-	26	16	-	-	-	1	-	-	12	47	3	-	-	28	-	-	-	-	-	18	-	13	13
Marshfield, . . .	1,725	-	-	-	-	1	5	-	2	-	-	-	-	20	2	-	-	-	18	2	-	-	-	-	1	-	1	-
Mashpee, . . .	263	-	-	-	-	-	1	-	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Mattapoisett, . .	1,352	-	-	-	1	1	-	-	-	-	-	-	-	6	1	-	-	-	-	-	-	-	-	-	2	-	-	4
Maynard, . . .	6,770	-	-	-	1	15	23	1	-	-	-	-	-	2	-	1	-	-	4	-	-	-	-	-	6	-	5	1

Medfield, . . .	3,648	-	-	-	-	3	1	-	-	-	-	-	-	-	21	-	1	-	19	-	1	19
Medford, . . .	30,509	-	-	4	-	20	41	2	-	-	-	-	-	-	634	1	1	78	7	-	21	13
Medway, . . .	2,846	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2	-	-	1	2
Melrose, . . .	16,880	-	2	1	34	38	-	-	8	-	-	-	-	-	472	40	62	-	-	27	3	15
Mendon, . . .	933	-	-	-	-	1	5	-	-	-	-	-	-	-	1	2	-	-	-	-	-	3
Merrimac, . . .	2,101	-	-	-	-	-	1	-	-	-	-	-	-	-	4	-	1	-	-	1	-	-
Methuen, . . .	14,007	-	1	1	2	21	-	-	2	-	-	-	-	-	61	-	24	-	-	12	1	4
Middleborough, . . .	8,631	-	-	-	11	18	2	-	-	-	-	-	-	-	3	2	3	-	-	24	1	2
Middlefield, ¹ . . .	325	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Middleton, . . .	1,308	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-
Milford, . . .	13,684	-	-	-	1	33	-	-	-	-	-	-	-	-	15	3	1	17	-	9	1	1
Millbury, . . .	5,295	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-
Millis, . . .	1,442	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Milton, . . .	8,600	-	-	-	25	23	-	2	-	-	-	-	-	-	328	6	2	27	47	13	-	4
Monroe, ¹ . . .	296	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monson, . . .	5,004	1	-	-	1	1	-	-	-	-	-	-	-	-	2	2	-	4	-	29	4	1
Montague, . . .	7,925	-	-	-	1	7	-	1	-	-	-	-	-	-	-	-	3	4	-	11	-	3
Monterey, ¹ . . .	358	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Montgomery, . . .	230	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-
Mount Washington, ¹ . . .	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nahant, . . .	1,387	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Nantucket, . . .	3,166	-	-	-	-	-	7	-	-	-	-	-	-	-	111	1	3	-	-	-	4	-
Natick, . . .	11,119	-	3	-	17	33	-	-	1	-	-	-	-	-	6	1	21	1	-	4	3	4

¹ No report.

Cases of Communicable Diseases reported to the Massachusetts State Department of Health during 1915 — Continued.

CITIES AND TOWNS ALPHABETICALLY AR- RANGED.	Population taken by the State as of 1915.	Actinomycosis.	Anterior Polio- mye- litis.	Anthrax.	Cerebrospinal Men- ingitis.	Chicken Pox.	Diphtheria.	Dog Bite.	Dysentery.	German Measles.	Glanders.	Leprosy.	Malaria.	Measles.	Mumps.	Ophthalmia.	Pellagra.	Rabies.	Scarlet Fever.	Septic Sore Throat.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmo- nary.	Tuberculosis, Other.	Typhoid Fever.	Whooping Cough.
Needham, ...	6,542	-	-	-	1	27	15	-	-	1	-	-	2	208	1	-	-	-	25	1	-	-	-	-	4	4	1	54
New Ashford, ¹	92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Bedford, ...	109,568	-	2	-	4	97	149	-	-	3	-	-	1	1,030	77	150	-	-	132	5	23	1	-	-	422	58	152	148
New Braintree, ¹	453	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Marlborough, ...	1,030	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	7	-
New Salem, ...	625	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Newbury, ...	1,590	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	3	-	-	-	-	-	-	-	-	-
Newburyport, ...	15,311	-	-	-	-	16	22	-	1	-	-	-	-	50	1	13	-	-	6	12	-	-	-	-	19	1	19	14
Newton, ...	43,113	-	5	-	-	90	78	7	10	47	-	-	14	293	44	26	1	-	123	4	-	-	-	-	56	7	24	296
Norfolk, ...	1,268	-	-	-	-	-	5	-	-	-	-	-	-	14	-	-	-	-	6	-	-	-	-	-	-	-	-	-
North Adams, ...	22,035	-	-	-	-	18	17	-	-	1	-	-	-	15	9	5	-	-	16	-	-	-	-	-	37	2	34	47
North Andover, ...	5,956	-	-	-	-	3	11	-	-	16	-	-	-	56	1	-	-	-	9	-	-	-	-	-	7	1	7	2
North Attleborough, ...	9,398	-	1	-	-	8	33	-	-	1	-	-	-	6	4	4	-	-	57	3	-	-	-	-	14	-	5	10
North Brookfield, ...	2,947	-	1	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	2	-	-	3
North Reading, ...	1,292	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Northampton, ...	21,654	-	-	-	-	46	16	-	-	1	-	-	-	12	4	5	4	-	48	1	-	1	1	1	87	3	8	86
Northborough, ...	1,797	-	-	-	-	2	1	-	-	1	-	-	-	4	-	-	-	-	1	-	-	-	-	-	4	-	1	-

	9	7	16	21	2
Northbridge,	9,254				2
Northfield,	1,782				10
Norton,	2,587				-
Norwell,	1,563				-
Norwood,	10,977				-
Oak Bluffs,	1,245				1
Oakham, ¹	527				1
Orange,	5,379				-
Orleans,	1,166				-
Otis, ¹	442				-
Oxford,	3,476				7
Palmer,	9,468				6
Paxton, ¹	471				-
Peabody,	18,625				23
Pelham, ¹	499				-
Pembroke,	1,337				1
Pepperell,	2,839				-
Peru, ¹	195				-
Petersham,	727				-
Phillipston,	390				-
Pittsfield,	39,607				37
Plainfield,	375				1
Plainville,	1,408				5

¹ No report.

Cases of Communicable Diseases reported to the Massachusetts State Department of Health during 1915 — Continued.

CITIES AND TOWNS ALPHABETICALLY AR- RANGED.	Population taken by the State as of 1915.	Aethinomyiasis.	Anterior Poliomye- litis.	Anthrax.	Cerebrospinal Men- ingitis.	Chicken Pox.	Diphtheria.	Dog Bite.	Dysentery.	German Measles.	Glanders.	Leprosy.	Malaria.	Measles.	Mumps.	Ophthalmia.	Pellagra.	Rabies.	Scarlet Fever.	Septic Sore Throat.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmo- nary.	Tuberculosis, Other.	Typhoid Fever.	Whooping Cough.
Plymouth,	12,926	-	-	-	-	1	18	-	-	-	-	-	-	51	4	2	-	-	12	-	-	-	6	-	12	-	10	-
Plympton,	599	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-	2	-	-	-	-	-	-	-	1	-
Prescott, 1.	299	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Princeton,	800	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1	-	-
Provincetown,	4,295	-	-	-	-	1	2	-	-	-	-	-	-	1	-	-	-	-	17	-	-	-	-	5	-	15	171	-
Quincy,	40,674	-	3	-	-	21	66	-	-	1	-	-	-	440	2	11	-	-	120	6	-	-	-	-	29	1	20	7
Randolph,	4,734	-	-	-	-	-	3	-	-	-	-	-	-	3	-	1	-	-	2	-	-	-	-	-	-	1	-	-
Raynham,	1,810	-	-	-	-	-	1	-	-	-	-	-	-	6	-	-	-	-	2	-	-	-	-	5	-	-	-	-
Reading,	6,805	-	-	-	-	1	15	-	-	-	-	-	-	65	-	1	-	-	11	-	-	-	-	-	1	2	-	-
Rehoboth,	2,228	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	4	-	-
Revere,	25,178	-	1	-	4	-	53	-	-	-	-	-	1	-	-	5	-	-	28	-	-	-	-	33	5	6	-	-
Richmond,	564	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rochester,	1,160	-	-	-	-	-	3	-	-	-	-	-	-	20	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Rockland,	7,074	-	-	-	-	1	2	-	-	-	-	-	-	7	1	1	-	-	9	-	-	-	-	5	-	-	14	-
Rockport,	4,351	-	-	-	-	-	39	-	-	-	-	-	-	9	-	2	-	-	31	-	-	-	1	-	5	1	3	7
Rowe,	424	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Rowley,	1,481	-	-	-	-	4	3	-	-	1	-	-	-	3	-	-	-	-	1	2	-	-	-	-	-	-	1	-

Cases of Communicable Diseases reported to the Massachusetts State Department of Health during 1915 — Continued.

CITIES AND TOWNS ALPHABETICALLY AR- RANGED.	Population taken by the State as of 1915.	Actinomycosis.	Anterior Poliomye- litis.	Anthrax.	Cerebrospinal Men- ingitis.	Chicken Pox.	Diphtheria.	Dog Bite.	Dysentery.	German Measles.	Glanders.	Leprosy.	Malaria.	Measles.	Mumps.	Ophthalmia.	Pellagra.	Rabies.	Scarlet Fever.	Septic Sore Throat.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmo- nary.	Tuberculosis, Other.	Typhoid Fever.	Whooping Cough.
Southbridge, . . .	14,217	-	-	-	-	7	69	2	-	-	-	-	-	-	6	1	4	-	1	-	-	-	-	-	24	3	6	-
Southwick, . . .	1,355	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	2	-	-	-	-	-	-	-	-	-	-	-
Spencer, . . .	5,994	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	2	1	1	1	1
Springfield, . . .	102,971	-	8	1	2	182	146	2	-	22	-	-	2	621	134	76	-	-	119	3	-	-	-	146	30	50	323	-
Sterling, . . .	1,403	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	1	-
Stockbridge, . . .	1,901	-	-	-	-	16	-	-	-	1	-	-	-	82	14	-	-	-	2	-	-	-	-	2	-	-	-	25
Stoneham, . . .	7,489	-	-	-	-	6	9	-	-	-	-	-	-	18	3	2	-	-	12	-	-	-	-	6	1	-	5	-
Stoughton, . . .	6,982	-	-	-	-	-	13	-	-	-	-	-	-	3	-	-	-	-	5	-	-	-	-	-	-	-	-	1
Stow, . . .	1,127	-	-	-	-	1	-	-	-	-	-	-	-	8	-	1	-	-	1	-	-	-	-	-	1	-	-	3
Sturbridge, . . .	1,618	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	5	-	-	-	-	-	-	-	-	6
Sudbury, . . .	1,206	-	-	-	-	3	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-
Sunderland, . . .	1,278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	12	-	-	-	-	-	-	-	-	-
Sutton, . . .	2,829	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	2	-	-	-	-	2	-	2	3	-
Swampscott, . . .	7,345	-	-	-	-	43	20	-	-	-	-	-	1	129	-	8	-	-	13	-	-	-	-	3	-	3	2	-
Swansea, . . .	2,558	-	-	-	-	3	9	-	-	-	-	-	-	23	-	-	-	-	4	-	-	-	-	2	-	-	-	-
Taunton, . . .	36,161	-	-	-	-	7	19	-	-	2	-	-	1	298	3	5	1	-	26	-	-	-	-	75	-	12	55	-
Templeton, . . .	4,081	-	-	-	-	-	5	-	-	-	-	-	-	-	-	1	-	-	3	-	-	-	-	4	-	-	-	-

[illegible]

¹ No report.

Cases of Communicable Diseases reported to the Massachusetts State Department of Health during 1915 — Concluded.

CITIES AND TOWNS ALPHABETICALLY AR- RANGED.	Population taken by the State as of 1915.	Actinomycosis.	Anterior Poliomye- litis.	Anthrax.	Cerebrospinal Men- ingitis.	Chicken Pox.	Diphtheria.	Dog Bite.	Dysentery.	German Measles.	Glanders.	Leprosy.	Malaria.	Measles.	Mumps.	Ophthalmia.	Pellagra.	Rabies.	Scarlet Fever.	Septic Sore Throat.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmo- nary.	Tuberculosis, Other.	Typhoid Fever.	Whooping Cough.
Wellfleet, . . .	936	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
Wendell, . . .	388	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	10	-	-	-	-	-	-	-	-	
Wenham, ¹ . . .	1,068	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
West Boylston, . .	1,318	-	-	-	-	7	1	-	2	2	-	-	-	1	5	1	-	-	2	-	-	-	-	3	-	1	6	
West Bridgewater, .	2,741	-	-	-	-	-	3	-	-	-	-	-	-	6	-	-	-	-	2	-	-	-	-	-	1	-	-	
West Brookfield, .	1,288	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	
West Newbury, . .	1,529	-	-	-	-	3	-	-	-	-	-	-	-	3	-	-	-	-	5	-	-	-	-	1	-	-	-	
West Springfield, .	11,339	-	1	-	-	9	43	-	1	-	-	-	-	2	-	3	-	-	7	-	-	-	-	2	-	1	36	
West Stockbridge, .	1,277	-	-	-	-	-	3	-	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	
West Tisbury, . . .	441	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	1	-	-	-	-	-	-	-	-	
Westborough, . . .	5,925	-	-	-	-	-	2	-	-	-	-	-	-	3	-	-	-	-	6	-	-	-	-	8	-	1	15	
Westfield, . . .	18,411	-	1	-	-	14	6	6	2	1	-	-	1	116	-	6	-	-	16	10	-	-	-	20	4	6	40	
Westford, . . .	2,843	-	1	-	1	7	4	-	-	-	-	-	-	2	-	-	-	-	22	-	-	-	-	-	-	2	2	
Westhampton, . . .	430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	
Westminster, . . .	1,594	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	3	-	-	-	-	2	-	1	-	
Weston, . . .	2,342	-	-	-	-	25	4	-	1	-	-	-	-	132	1	1	-	-	12	4	-	-	-	3	-	-	4	
Westport, . . .	3,262	-	-	-	-	-	5	-	-	1	-	-	-	14	8	-	-	-	8	-	-	-	-	2	-	5	4	

[illegible]

1 No report.

Cases of Certain Communicable Diseases, arranged by Months.

	Anterior Polio- myelitis.	Cerebro- spinal Meningitis.	Diphtheria.	Dog Bite.	Malaria.
January, ...	5	12	832	5	-
February, ...	4	12	681	9	4
March, ...	6	14	737	19	4
April, ...	5	15	648	23	3
May, ...	5	18	710	15	8
June, ...	4	19	609	28	18
July, ...	9	12	513	23	23
August, ...	26	10	564	18	27
September, ...	15	4	697	9	6
October, ...	28	13	1,091	14	14
November, ...	16	7	1,181	5	5
December, ...	12	9	1,019	6	-
	135	145	9,282	174	112

	Measles.	Pellagra.	Rabies.	Scarlet Fever.	Septic Sore Throat.
January, ...	1,068	1	1	858	28
February, ...	1,554	-	1	836	24
March, ...	3,016	-	1	932	50
April, ...	4,409	2	-	1,072	117
May, ...	4,198	2	-	1,129	544
June, ...	4,054	6	-	885	33
July, ...	1,638	8	-	400	17
August, ...	370	4	2	274	5
September, ...	156	5	-	299	5
October, ...	356	-	-	439	9
November, ...	752	5	-	644	7
December, ...	1,310	-	-	845	26
	22,881	33	5	8,613	865

Cases of Certain Communicable Diseases, arranged by Months — Concluded.

	Smallpox.	Tetanus.	Tuber- culosis, Pul- monary.	Typhoid Fever.	Whooping Cough.
January, ...	-	4	633	105	514
February, ...	-	1	573	106	608
March, ...	-	5	750	111	613
April, ...	-	1	727	72	536
May, ...	5	-	884	130	622
June, ...	17	6	709	103	608
July, ...	2	4	723	174	587
August, ...	-	4	618	265	489
September, ...	-	2	610	322	465
October, ...	-	2	666	412	600
November, ...	-	1	581	255	780
December, ...	-	2	572	149	760
	24	32	8,046	2,204	7,182

REPORT OF THE BACTERIOLOGIST.

During the year ended Nov. 30, 1915, the work of the Diagnostic Laboratory has steadily increased along all lines. This would seem to indicate that physicians are using this and other laboratories in the State to a greater extent than ever before. Seventeen thousand one hundred and eighty-nine specimens have been examined, an increase of 44 per cent. over the number of the previous year. To defray the expenses of the laboratory \$5,300 was appropriated. The cost per examination has been 30 cents. The increased work has been accomplished with a decrease in the cost per specimen, a fact which is largely due to the willingness of the laboratory staff to work overtime with no extra compensation. The following table summarizes the work of the laboratory for the last six years.

Total Examinations made by the Diagnostic Laboratory, 1910-15.

1910, ...	6,458
1911, ...	7,817
1912, ...	7,854
1913, ...	10,701
1914, ...	11,924
1915, ...	17,189

The policy of this laboratory is to examine specimens from individuals suffering from diseases which affect the public health. At present there are no facilities for undertaking pathological work, such as urine analysis and examination of blood for anæmia, etc., which belongs rightly to private laboratories.

Considerable work has been done of a preventive nature in the examination of several thousand cultures from the throats of school children in various towns throughout the State when diphtheria was noticeably prevalent; also the blood of persons who handle food in some of the State institutions has been tested for the Widal reaction for typhoid fever; by this means the detection of chronic typhoid carriers may be accomplished.

To be of value to the State the laboratory must give as quick service to the physician as is consistent with accuracy. With this thought in mind the whole staff has worked throughout the year.

CHARACTER OF THE WORK OF THE LABORATORY.

The routine work of the laboratory consists of the examination of primary and secondary cultures for diphtheria; specimens of sputum and other materials for tubercle bacilli; examination of blood for the Widal reaction for typhoid fever; examination of blood, bowel discharges and urine for typhoid bacilli; examination of smears for gonococci and meningococci; examination of blood for malarial parasites; various miscellaneous examinations, such as virulence tests of diphtheria bacilli, examination of milk for pus, etc.

*Diphtheria.**Cultures classified.*

	Positive.	Negative.	Total.
Primary, ...	1,100	6,386	7,486
Secondary (for release from quarantine), ...	906	2,206	3,112
Total, ...	2,006	8,592	10,598

All cultures for diagnosis are examined three times: (1) an examination is made of the material left on the swab after the culture has been made from it; (2) the culture is examined after three to eight hours' incubation; (3) the culture is examined after fourteen to twenty hours' incubation.

Of the total number of cultures received for diagnosis, approximately 85 per cent. were diagnosed by swab examination or after a short period of incubation. In this way the laboratory was able to send a report to the attending physician on the day the culture was received. Cultures proving negative on the day of their receipt are incubated over night and reported the following morning. All cultures for release from quarantine are reported on the morning following their receipt, as it is advisable to allow those cultures to grow at least fourteen hours before giving a negative report.

Approximately 3,000 cultures taken from children attending schools where two or more cases of diphtheria had been reported have been examined during the year. Several missed cases and carriers were discovered by this means. Although the results were not always successful in stopping diphtheria in a school, the stimulation given to school inspection was most valuable.

As a result of the school culture work this year the following facts

regarding carriers have been ascertained. In schools having an occasional case, from one-third to one-half of 1 per cent. of the pupils were found to harbor virulent diphtheria bacilli in nose or throat. In schools having a noticeable number of cases, one-half of 1 per cent. were found to be carriers.

In institutions and boarding schools where diphtheria was prevalent, a larger percentage of the pupils were found to be carriers, for example, in one school 8 per cent. In this school after the first few cases occurred an immunizing dose of antitoxin was given to the other pupils, and no cultures were taken for a few weeks. An opportunity was given meanwhile for one or more carriers to infect other pupils who were immune temporarily and showed no symptoms. Thus the infection became more widespread. It would appear as though this situation could have been avoided had cultures been taken of all contacts as soon as the first cases occurred and all carriers quarantined.

Tuberculosis.

A total of 2,794 specimens of sputum were examined, of which 684, or 24.4 per cent., were found positive. There has been only a slight increase in the number of specimens examined over the previous year. It is to be regretted that physicians seldom send a second specimen from a patient after the first has been reported negative.

Specimens of Sputum examined.

Positive, ...	684
Negative, ...	2,110
Total, ...	2,794

Typhoid Fever.

The following table shows the positive, negative and atypical specimens of blood examined for the Widal reaction for typhoid fever. The majority of the atypical reactions were obtained with specimens of blood taken early in the disease. Physicians are constantly reminded when a negative report is sent that if it is but a week or ten days since the date of the first symptoms, it may be too early for a positive reaction and second specimens are advised.

Examination of Blood for Widal Reaction.

Positive, ...	425
Negative, ...	1,693
Atypical, ...	130
Total, ...	2,248

Examination of Blood, Feces and Urine for Typhoid Bacilli. — During the year, 375 cultures have been received of the blood, bowel discharges and urine from 260 persons either suspected of having typhoid fever or of being typhoid carriers and from persons convalescing from typhoid fever. From these cultures the typhoid bacillus has been isolated 23 times, from the blood in 1 case, from the feces in 20 cases and from the urine in 2 cases. There were 106 cultures sent from sick persons, 183 from convalescents, 81 from suspected carriers and 5 not stated.

Of the positive cultures, 8 were from sick persons, 8 from convalescents and 7 from suspected carriers. Only 3 carriers were represented, the typhoid bacilli being isolated from the feces of one person five times.

Two of the carriers apprehended were engaged in the handling of food: one a cook in an insane hospital where there were 24 cases of typhoid fever, and the other a dairyman in a town that had a milk outbreak of typhoid. These persons had a history of typhoid fever many years before.

Paratyphoid Fever.

When requested the laboratory tests specimens of blood for the Widal reaction for paratyphoid fever. In the few positives obtained the reaction for typhoid fever was also shown. Doubtless some of the so-called typhoid fever is paratyphoid fever, and on account of group agglutinins a positive reaction is obtained with both typhoid and paratyphoid bacilli. Time does not permit the differentiation between the two diseases in the routine work, because as far as the public health is concerned the problem is the same in both diseases. An interesting line of research is suggested, especially as bacilli which show the cultural characters of paratyphoid bacilli are occasionally isolated from feces and urine of convalescents and others. We do not as yet understand the full significance of these bacilli.

Malaria.

The usual small number of specimens of blood has been examined for the presence of the malarial parasites. Physicians apparently rely upon their own diagnosis of malaria almost entirely.

	<i>Specimens of Blood examined.</i>	
Positive,		3
Negative,		55
Total,		58

Miscellaneous Examinations.

During the year, 1,186 miscellaneous examinations have been made. The majority of these were smears sent by the State Board of Charity to be examined for gonococci. Very few specimens of this kind are sent by other physicians, as it has not been the custom of the laboratory in previous years to examine such specimens. The other examinations were of spinal fluid for meningococci, milk for pus, and virulence tests of diphtheria bacilli isolated from healthy carriers or convalescents.

In the near future the diagnostic laboratory will send out an outfit which can be used for smears from suspected gonorrhœa. It is hoped by this means to get more specimens from the eyes of the new born and more data on ophthalmia neonatorum.

In the routine work the following procedure is employed: all diphtheria cultures for diagnosis are examined twice the day of their receipt. As many as are positive that day are reported at once. The negatives, after a third examination, and all release cultures are reported the following morning at 9 o'clock, by telephone, if requested, and by mail.

All specimens of sputum and all specimens of blood to be tested for the Widal reaction are examined and reported the day they are received.

Reports on typhoid cultures are not promised inside of five days from the date of receipt of specimens; the average time is three days.

FUTURE DEVELOPMENT.

The problem for the past year has been the improvement of the service by avoiding all delays in examination of specimens and the reporting of results obtained. The fact has been emphasized sharply that speed in the laboratory will not compensate for geographical distance from it. However, undue emphasis has been placed upon distance from the laboratory in many instances. Physicians often expect impossibly quick returns, and they do not wish to go to the expense of having reports telephoned to them. Part of the health appropriation of towns might be spent to considerable advantage in having reports from the laboratory telephoned to the local board of health.

Since few physicians can be their own bacteriologists, the question of the best solution of their problems is pertinent. There are already some thirty or forty municipal laboratories in existence in Massachusetts besides hospital and private laboratories. It is doubtful if it is

necessary to establish any more. It is even possible that it might be economical for some of these to combine and maintain but one laboratory. A full-time bacteriologist can always keep his "diagnostic eye" in training better than a person who sees only an occasional specimen.

It would seem desirable for the State to maintain two laboratories, one in Boston and one in a railroad center, such as Springfield, whose laboratories already do considerable work for surrounding towns.

It would be distinctly advantageous if there could be more co-operation between local laboratories and the State laboratory. Time might be saved in averting the spread of disease if local laboratories reported positive examinations daily to the State, so that State District Health Officers could be informed of cases of diphtheria and typhoid fever sooner than if the reports came through the physician and local board of health to them. Unless the local laboratory passes on its information regarding prevalence of disease to the proper authorities as quickly as possible, whatever advantage it may have in being able to examine specimens quickly is partially nullified.

Number and Kinds of Outfits distributed by the Diagnostic Laboratory during the Year ended Nov. 30, 1915.

	Culture Tubes.	Sputum Outfits.	Widals.	Typhoid Cultures.	Malarias.
1914.					
December, ...	678	237	107	12	6
1915.					
January, ...	1,026	351	131	12	6
February, ...	714	259	129	29	12
March, ...	636	385	360	74	9
April, ...	1,059	399	90	22	6
May, ...	570	324	240	6	3
June, ...	744	513	166	23	13
July, ...	497	327	207	63	—
August, ...	819	313	473	84	11
September, ...	946	300	266	111	42
October, ...	2,912	409	533	81	23
November, ...	2,907	405	348	59	12
Totals, ...	13,508	4,222	3,050	576	143

Total number of outfits distributed, 22,314.

Gonorrhœa slides for State Board of Charity, 815.

REPORT UPON THE DIPHTHERIA CULTURES EXAMINED DURING THE YEAR ENDING NOV. 30, 1915.

From Dec. 1, 1914, to Nov. 30, 1915, 10,528 cultures were received from 213 cities and towns in the State. Of these cultures, 7,342 were for the purpose of diagnosis and 3,186 were for release from quarantine. Of the cultures examined for diagnosis, 1,090 were positive for diphtheria and 6,252 were negative. A considerable number of cultures were unsatisfactory, due to the presence of contaminating organisms or insufficient growth. All swabs received for diagnosis were examined soon after their arrival at the laboratory, and it was possible to make a positive diagnosis on 586, or 54 per cent., of the total number which proved positive on culture.

The following table gives the number of cultures received from the different cities and towns and the results of the examinations: —

CITY OR TOWN.	Whole Number of Cultures examined.	CULTURES EXAMINED FOR DIAGNOSIS.			CULTURES EXAMINED FOR RELEASE FROM QUARANTINE.		
		Positive.	Negative.	Unsatisfactory.	Positive.	Negative.	Unsatisfactory.
Abington, . . .	1	—	1	—	—	—	—
Acton, . . .	16	4	2	—	2	7	1
Adams, . . .	2	—	2	—	—	—	—
Agawam, . . .	38	2	29	3	1	3	—
Amesbury, . .	12	1	6	—	1	4	—
Amherst, . . .	108	8	68	1	8	19	4
Andover, . . .	52	9	21	1	8	12	1
Arlington, . .	1	—	—	1	—	—	—
Ashburnham, .	9	3	1	—	1	4	—
Ashfield, . . .	3	—	2	—	—	1	—
Ashland, . . .	1	—	—	—	—	1	—
Athol, . . .	1	—	1	—	—	—	—
ATTLEBOROUGH, .	267	21	162	4	23	54	3
Auburn, . . .	9	2	2	1	2	2	—
Avon, . . .	8	—	4	—	2	2	—
Ayer, . . .	14	3	6	1	1	3	—

CITY OR TOWN.	Whole Number of Cultures examined.	CULTURES EXAMINED FOR DIAGNOSIS.			CULTURES EXAMINED FOR RELEASE FROM QUARANTINE.		
		Positive.	Negative.	Unsatisfactory.	Positive.	Negative.	Unsatisfactory.
Barnstable, . . .	25	1	14	-	1	9	-
Barre, . . .	31	1	21	-	1	8	-
Bedford, . . .	2	-	1	1	-	-	-
Belchertown, . . .	5	-	5	-	-	-	-
Belmont, . . .	9	1	8	-	-	-	-
BEVERLY, . . .	309	42	76	5	56	120	10
Billerica, . . .	4	1	-	-	1	2	-
Blackstone, . . .	5	4	1	-	-	-	-
Boston, . . .	29	3	17	3	2	4	-
Bourne, . . .	31	4	11	-	4	11	1
Braintree, . . .	28	4	19	1	1	3	-
Brewster, . . .	4	1	2	-	-	1	-
Bridgewater, . . .	10	2	5	-	1	2	-
Brimfield, . . .	1	-	1	-	-	-	-
Brockton, . . .	2	-	1	-	-	1	-
Brookfield, . . .	2	1	-	-	-	1	-
Buckland, . . .	2	2	-	-	-	-	-
Burlington, . . .	2	-	2	-	-	-	-
CAMBRIDGE, . . .	1	-	1	-	-	-	-
Canton, . . .	14	5	1	-	3	5	-
Carver, . . .	3	2	1	-	-	-	-
Charlemont, . . .	2	-	2	-	-	-	-
Chatham, . . .	10	2	2	1	1	3	1
Chelmsford, . . .	5	1	2	-	-	2	-
CHELSEA, . . .	26	3	10	-	1	12	-
Chesterfield, . . .	5	-	1	-	2	2	-
Cohasset, . . .	27	-	22	3	-	2	-
Colrain, . . .	2	-	2	-	-	-	-
Concord, . . .	9	2	3	-	-	3	1
Conway, . . .	1	-	1	-	-	-	-
Dana, . . .	2	-	2	-	-	-	-
Danvers, . . .	500	29	384	11	19	39	18
Dartmouth, . . .	8	2	1	-	4	1	-
Deerfield, . . .	1	-	1	-	-	-	-
Dennis, . . .	5	1	1	1	-	2	-
Dover, . . .	4	-	2	-	-	2	-
Dudley, . . .	2	1	-	-	-	1	-

CITY OR TOWN.	Whole Number of Cultures examined.	CULTURES EXAMINED FOR DIAGNOSIS.			CULTURES EXAMINED FOR RELEASE FROM QUARANTINE.		
		Positive.	Negative.	Unsatisfactory.	Positive.	Negative.	Unsatisfactory.
Duxbury, . . .	32	2	1	-	11	18	-
East Bridgewater, .	10	-	5	-	1	4	-
Eastham, . . .	23	6	2	-	9	6	-
Easthampton, . .	2	-	-	-	-	2	-
Easton, . . .	18	3	6	-	1	7	1
Edgartown, . .	458	18	269	3	18	145	5
Erving, . . .	3	-	3	-	-	-	-
Essex, . . .	1	-	-	-	-	1	-
EVERETT, . . .	331	70	105	9	41	100	6
Fairhaven, . .	3	-	3	-	-	-	-
Falmouth, . . .	59	10	11	2	12	21	3
FITCHBURG, . .	1	-	-	-	-	1	-
Foxborough, . .	27	3	21	1	-	2	-
Framingham, . .	4	-	2	2	-	-	-
Franklin, . . .	3	-	3	-	-	-	-
Georgetown, . .	12	-	12	-	-	-	-
GLOUCESTER, . .	2	1	1	-	-	-	-
Grafton, . . .	7	2	4	1	-	-	-
Granby, . . .	1	-	-	-	-	1	-
Granville, . . .	4	1	2	-	-	1	-
Greenfield, . .	40	3	24	1	4	7	1
Groton, . . .	44	6	16	1	2	16	3
Hamilton, . . .	2	-	2	-	-	-	-
Hanover, . . .	19	2	11	-	1	5	-
Hanson, . . .	1	-	1	-	-	-	-
Hardwick, . . .	1	-	1	-	-	-	-
Harvard, . . .	4	-	4	-	-	-	-
Harwich, . . .	6	-	5	-	-	1	-
HAVERHILL, . .	1	-	1	-	-	-	-
Hingham, . . .	37	3	22	4	3	5	-
Holbrook, . . .	51	6	16	2	14	10	3
Holliston, . . .	9	-	6	1	-	1	1
Hopedale, . . .	1	-	1	-	-	-	-
Hopkinton, . .	9	1	3	-	2	3	-
Hubbardston, . .	1	-	1	-	-	-	-
Hudson, . . .	387	34	315	7	11	20	-
Hull, . . .	69	10	26	1	11	19	2

CITY OR TOWN.	Whole Number of Cultures examined.	CULTURES EXAMINED FOR DIAGNOSIS.			CULTURES EXAMINED FOR RELEASE FROM QUARANTINE.		
		Positive.	Negative.	Unsatisfactory.	Positive.	Negative.	Unsatisfactory.
Ipswich, . . .	21	3	7	-	1	6	4
Kingston, . . .	2	-	2	-	-	-	-
Lee, ...	3	-	2	1	-	-	-
Leverett, . . .	1	-	1	-	-	-	-
Leyden, ...	25	3	18	1	-	3	-
Lincoln, ...	1	-	1	-	-	-	-
Littleton, . . .	3	-	3	-	-	-	-
Lynnfield, . . .	1	-	1	-	-	-	-
MALDEN, ...	19	5	9	-	3	2	-
Manchester, . . .	3	1	1	-	-	1	-
Mansfield, . . .	14	1	13	-	-	-	-
Marblehead, . . .	829	42	619	6	61	95	6
Marion, ...	1	-	1	-	-	-	-
MARLBOROUGH, .	242	20	209	4	2	7	-
Marshfield, . . .	31	4	10	-	6	9	2
Maynard, ...	74	16	27	4	10	17	-
Medfield, ...	15	3	7	1	2	2	-
MEDFORD, ...	167	29	62	2	23	48	3
Medway, ...	3	1	1	-	-	1	-
MELROSE, ...	252	31	99	8	47	65	2
Mendon, ...	1	1	-	-	-	-	-
Merrimac, ...	6	-	-	-	8	-	-
Methuen, ...	9	3	5	-	-	1	-
Middleborough, .	39	4	20	3	2	10	-
Middleton, . . .	3	-	3	-	-	-	-
Milford, ...	5	1	4	-	-	-	-
Millbury, ...	1	-	1	-	-	-	-
Millis, ...	2	-	1	1	-	-	-
Milton, ...	87	8	55	2	4	18	-
Monson, ...	25	1	22	1	-	1	-
Montague, ...	1	1	-	-	-	-	-
Nantucket, . . .	1	1	-	-	-	-	-
Natick, ...	88	20	30	2	10	25	1
Newbury, ...	3	-	3	-	-	-	-
NEWTON, ...	1	-	1	-	-	-	-
Norfolk, ...	9	3	2	-	2	2	-
North Andover, .	7	5	2	-	-	-	-

CITY OR TOWN.	Whole Number of Cultures examined.	CULTURES EXAMINED FOR DIAGNOSIS.			CULTURES EXAMINED FOR RELEASE FROM QUARANTINE.		
		Positive.	Negative.	Unsatisfactory.	Positive.	Negative.	Unsatisfactory.
North Attleborough,	215	25	48	5	52	82	3
North Brookfield, .	12	3	7	-	1	1	-
North Reading, .	68	6	31	2	14	13	2
NORTHAMPTON, .	13	3	2	-	4	4	-
Northbridge, . .	32	8	12	-	2	10	-
Northfield, . .	11	-	7	-	-	4	-
Norton, . . .	12	1	1	-	5	5	-
Norwell, . . .	3	-	3	-	-	-	-
Norwood, . . .	109	17	36	2	4	46	4
Oak Bluffs, . .	53	2	15	2	3	28	2
Oakham, . . .	1	-	1	-	-	-	-
Orange, . . .	24	8	6	-	2	7	1
Orleans, . . .	5	1	3	-	-	1	-
Oxford, . . .	4	-	2	-	1	1	-
Palmer, . . .	11	1	7	1	-	1	1
Peabody, . . .	71	12	33	4	6	15	1
Pembroke, . .	25	5	2	-	6	11	1
Pepperell, . . .	16	3	3	-	2	6	2
Petersham, . .	33	5	19	-	1	8	-
Plainville, . .	18	5	4	-	3	5	1
Plymouth, . .	3	1	2	-	-	-	-
Provincetown, .	10	-	10	-	-	-	-
QUINCY, . . .	242	34	93	6	43	60	6
Randolph, . .	13	1	10	-	1	1	-
Raynham, . . .	1	-	1	-	-	-	-
Reading, . . .	71	12	22	3	16	15	3
REVERE, . . .	315	50	135	11	34	77	8
Rochester, . .	4	1	-	-	1	1	1
Rockland, . . .	18	2	10	-	1	4	1
Rockport, . . .	305	19	219	4	29	33	1
Rowley, . . .	4	2	-	-	-	2	-
Royalston, . .	72	2	65	2	2	1	-
SALEM, . . .	160	19	49	3	28	56	5
Saugus, . . .	90	11	38	3	8	29	1
Scituate, . . .	36	5	8	1	4	18	-
Sharon, . . .	12	1	9	-	1	1	-
Sheffield, . . .	1	1	-	-	-	-	-

CITY OR TOWN.	Whole Number of Cultures examined.	CULTURES EXAMINED FOR DIAGNOSIS.			CULTURES EXAMINED FOR RELEASE FROM QUARANTINE.		
		Positive.	Negative.	Unsatisfactory.	Positive.	Negative.	Unsatisfactory.
Sherborn, . . .	3	-	3	-	-	-	-
Shirley, . . .	358	31	227	17	32	49	2
SOMERVILLE, . . .	4	-	3	-	1	-	-
South Hadley, . . .	2	-	2	-	-	-	-
Southborough, . . .	3	-	3	-	-	-	-
Southbridge, . . .	129	32	39	4	10	42	2
Spencer, . . .	5	1	2	-	1	1	-
Stoneham, . . .	76	14	22	3	11	24	2
Stoughton, . . .	27	6	6	-	9	6	-
Stow, . . .	1	-	1	-	-	-	-
Sturbridge, . . .	2	-	2	-	-	-	-
Sunderland, . . .	2	-	2	-	-	-	-
Sutton, . . .	2	-	2	-	-	-	-
Swampscott, . . .	14	2	1	-	6	4	1
Swansea, . . .	1	-	1	-	-	-	-
TAUNTON, . . .	30	3	23	2	-	2	-
Templeton, . . .	5	1	4	-	-	-	-
Tisbury, . . .	63	1	55	1	-	6	-
Topsfield, . . .	6	-	5	1	-	-	-
Townsend, . . .	5	1	3	-	-	1	-
Truro, . . .	6	1	1	-	2	1	1
Uxbridge, . . .	61	22	11	-	7	20	1
Wakefield, . . .	98	11	46	3	19	19	-
Walpole, . . .	143	16	75	7	17	25	3
WALTHAM, . . .	654	21	587	12	8	26	-
Wareham, . . .	9	1	6	-	-	2	-
Warren, . . .	3	1	2	-	-	-	-
Watertown, . . .	112	15	74	5	3	14	1
Wayland, . . .	189	5	166	1	7	7	3
Webster, . . .	1	-	1	-	-	-	-
Wellfleet, . . .	1	-	1	-	-	-	-
Wenham, . . .	14	1	2	-	1	10	-
West Springfield, . . .	4	2	1	-	-	1	-
Westborough, . . .	12	1	11	-	-	-	-
Westfield, . . .	11	-	9	2	-	-	-
Westford, . . .	1	-	1	-	-	-	-
Westport, . . .	11	2	8	-	-	1	-

CITY OR TOWN.	Whole Number of Cultures examined.	CULTURES EXAMINED FOR DIAGNOSIS.			CULTURES EXAMINED FOR RELEASE FROM QUARANTINE.		
		Positive.	Negative.	Unsatis- factory.	Positive.	Negative.	Unsatis- factory.
Weymouth, . . .	58	7	32	3	3	13	-
Whitman, . . .	2	-	2	-	-	-	-
Williamsburg, . . .	1	-	1	-	-	-	-
Williamstown, . . .	1	-	1	-	-	-	-
Wilmington, . . .	9	-	8	1	-	-	-
Winchendon, . . .	33	5	13	2	4	7	2
Winchester, . . .	348	20	219	3	6	98	2
Windsor, . . .	1	-	1	-	-	-	-
Winthrop, . . .	72	14	30	5	5	17	1
WOBURN, . . .	466	28	291	8	30	103	6
Wrentham, . . .	14	-	13	-	-	1	-
Yarmouth, . . .	14	2	5	-	1	6	-
Totals, . . .	10,528	1,090	6,014	238	923	2,109	154

REPORT UPON THE EXAMINATION OF SPUTUM AND OTHER MATERIAL SUSPECTED OF CONTAINING THE BACILLI OF TUBERCULOSIS.

From Dec. 1, 1914, to Nov. 30, 1915, microscopical examination has been made of 2,794 lots of sputum and other material suspected of containing the bacilli of tuberculosis. This material has been received from 214 cities and towns in the State. The following table gives the places from which the material has been received and the results of the microscopical examinations:—

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.
Abington, ...	11	1	10	Belmont, ...	5	—	5
Acton, ...	5	1	4	BEVERLY, ...	45	9	36
Adams, ...	14	6	8	BillERICA, ...	1	—	1
Amesbury, ...	33	7	26	Blackstone, ...	8	4	4
Amherst, ...	36	3	33	BOSTON, ...	11	5	6
Andover, ...	19	8	11	Bourne, ...	6	1	5
Arlington, ...	6	2	4	Boxford, ...	2	—	2
Ashburnham, ...	1	—	1	Boylston, ...	1	—	1
Ashby, ...	1	—	1	Braintree, ...	16	6	10
Ashland, ...	2	—	2	Bridgewater, ...	6	2	4
Athol, ...	19	7	12	BROCKTON, ...	3	1	2
ATTLEBORO, ...	88	11	77	Brookfield, ...	4	2	2
Avon, ...	1	—	1	Brookline, ...	1	—	1
Ayer, ...	2	1	1	Buckland, ...	3	1	2
Barnstable, ...	10	5	5	Burlington, ...	1	1	—
Barre, ...	1	—	1	CAMBRIDGE, ...	7	4	3
Becket, ...	1	1	—	Carver, ...	1	—	1
Bedford, ...	1	—	1	Charlemont, ...	2	—	2
Belchertown, ...	5	—	5	Charlton, ...	2	—	2

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.
Chelmsford, ...	4	-	4	Hadley, ...	4	-	4
CHELSEA, ...	14	6	8	Halifax, ...	1	-	1
Chesterfield, ...	2	1	1	Hamilton, ...	3	1	2
Cohasset, ...	26	-	26	Hanover, ...	3	1	2
Colrain, ...	4	1	3	Harvard, ...	3	-	3
Concord, ...	9	3	6	Harwich, ...	7	3	4
Cummington, ...	1	1	-	Hatfield, ...	6	-	6
Dalton, ...	4	-	4	HAVERHILL, ...	3	1	2
Danvers, ...	33	4	29	Hingham, ...	35	1	34
Dartmouth, ...	1	-	1	Holbrook, ...	5	1	4
Deerfield, ...	2	1	1	Holden, ...	3	1	2
Dennis, ...	3	-	3	Holliston, ...	2	1	1
Dover, ...	1	-	1	Hopedale, ...	4	-	4
Dudley, ...	5	-	5	Hopkinton, ...	4	-	4
Duxbury, ...	4	1	3	Hudson, ...	8	-	8
East Bridgewater, ...	12	3	9	Hull, ...	15	2	13
East Longmeadow, ...	1	-	1	Huntington, ...	1	-	1
Easthampton, ...	10	3	7	Ipswich, ...	10	2	8
Easton, ...	1	-	1	Kingston, ...	1	1	-
Edgartown, ...	1	-	1	Lakeville, ...	1	-	1
Enfield, ...	1	-	1	Lancaster, ...	2	-	2
Essex, ...	3	-	3	LAWRENCE, ...	7	3	4
EVERETT, ...	115	29	86	Leicester, ...	1	1	-
FALL RIVER, ...	5	2	3	Lenox, ...	6	3	3
Falmouth, ...	6	2	4	Lexington, ...	9	6	3
Foxborough, ...	13	4	9	LOWELL, ...	2	1	1
Framingham, ...	6	-	6	Lynnfield, ...	2	1	1
Franklin, ...	22	10	12	MALDEN, ...	5	-	5
Gill, ...	1	-	1	Manchester, ...	7	2	5
GLOUCESTER, ...	67	24	43	Mansfield, ...	26	8	18
Grafton, ...	7	2	5	Marblehead, ...	1	-	1
Granby, ...	4	-	4	MARLBOROUGH, ...	25	2	23
Granville, ...	1	-	1	Marshfield, ...	6	1	5
Great Barrington, ...	19	8	11	Maynard, ...	21	10	11
Greenfield, ...	16	6	10	Medfield, ...	5	1	4
Groton, ...	1	-	1	MEDFORD, ...	51	4	47

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.
Medway, ...	2	1	1	Plainville, ...	3	-	3
MELROSE, ...	59	13	46	Plymouth, ...	6	2	4
Merrimac, ...	1	-	1	Provincetown, ...	16	4	12
Methuen, ...	13	2	11	QUINCY, ...	141	38	103
Middleborough, ...	8	3	5	Randolph, ...	8	2	6
Middleton, ...	1	-	1	Raynham, ...	4	4	-
Milford, ...	49	17	32	Reading, ...	42	7	35
Millis, ...	1	-	1	REVERE, ...	53	14	39
Milton, ...	9	3	6	Rochester, ...	1	-	1
Montague, ...	2	-	2	Rockland, ...	9	3	6
Montgomery, ...	1	-	1	Rockport, ...	16	3	13
Natick, ...	19	2	17	SALEM, ...	186	56	130
Needham, ...	1	-	1	Sandwich, ...	1	-	1
New Salem, ...	1	-	1	Saugus, ...	26	1	25
Newbury, ...	1	-	1	Scituate, ...	6	1	5
NEWBURYPORT, ...	3	-	3	Shelburne, ...	1	-	1
NEWTON, ...	5	1	4	Shirley, ...	4	-	4
Norfolk, ...	2	1	1	SOMERVILLE, ...	6	-	6
NORTH ADAMS, ...	8	3	5	South Hadley, ...	15	4	11
North Andover, ...	1	1	-	Southampton, ...	1	1	-
North Attleborough, ...	57	8	49	Southbridge, ...	37	11	26
North Brookfield, ...	12	2	10	Spencer, ...	9	2	7
North Reading, ...	4	3	1	Stockbridge, ...	1	1	-
Northbridge, ...	18	8	10	Stoneham, ...	19	4	15
Northfield, ...	16	2	14	Stoughton, ...	11	2	9
Norton, ...	8	-	8	Stow, ...	1	-	1
Norwood, ...	11	-	11	Sturbridge, ...	3	-	3
Oak Bluffs, ...	6	3	3	Sudbury, ...	1	1	-
Orange, ...	1	-	1	Sunderland, ...	1	-	1
Orleans, ...	2	-	2	Sutton, ...	1	-	1
Oxford, ...	2	1	1	TAUNTON, ...	89	18	71
Palmer, ...	11	2	9	Templeton, ...	1	-	1
Peabody, ...	84	18	66	Tewksbury, ...	5	2	3
Pembroke, ...	2	1	1	Tisbury, ...	2	-	2
Petersham, ...	1	-	1	Topsfield, ...	4	-	4
PITTSFIELD, ...	160	68	92	Townsend, ...	10	3	7

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.
Upton, ...	1	-	1	Westford, ...	4	-	4
Uxbridge, ...	7	2	5	Westhampton, ...	1	1	-
Wakefield, ...	59	8	51	Westport, ...	6	-	6
Walpole, ...	18	4	14	Weymouth, ...	21	7	14
WALTHAM, ...	4	1	3	Whately, ...	1	-	1
Ware, ...	27	11	16	Whitman, ...	6	1	5
Wareham, ...	5	-	5	Williamstown, ...	8	1	7
Warren, ...	7	2	5	Wilmington, ...	16	1	15
Washington, ...	1	-	1	Winchendon, ...	11	3	8
Watertown, ...	14	2	12	Winchester, ...	35	9	26
Wayland, ...	8	1	7	Winthrop, ...	30	10	20
Webster, ...	17	4	13	WOBURN, ...	31	8	23
Wellesley, ...	1	-	1	WORCESTER, ...	1	-	1
West Bridgewater, ...	1	-	1	Wrentham, ...	6	-	6
West Brookfield, ...	4	-	4	Yarmouth, ...	2	-	2
Westborough, ...	3	1	2	Totals, ...	2,794	684	2,110
Westfield, ...	15	2	13				

REPORT UPON THE EXAMINATIONS FOR MALARIA.

From Dec. 1, 1914, to Nov. 30, 1915, 58 blood specimens were examined for the presence of malarial parasites. The percentage of positive cases was 5.17.

The following table shows the city or town from which the specimens, positive and negative, were received:—

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.
Auburn, ...	1	-	1	Norwell, ...	1	-	1
Braintree, ...	4	-	4	Norwood, ...	4	-	4
Dedham, ...	1	-	1	Orange, ...	1	-	1
EVERETT, ...	1	-	1	PITTSFIELD, ...	3	1	2
Hopkinton, ...	1	-	1	Stoneham, ...	1	-	1
Hull, ...	1	-	1	Swampscott, ...	1	1	-
MELROSE, ...	9	-	9	Walpole, ...	2	1	1
Milford, ...	1	-	1	Watertown, ...	1	-	1
Natick, ...	8	-	8	Winchester, ...	4	-	4
NEWTON, ...	5	-	5	WOBURN, ...	2	-	2
North Attleborough, ...	3	-	3	Totals, ...	58	3	55
North Reading, ...	3	-	3				

REPORT UPON THE EXAMINATIONS FOR TYPHOID FEVER.

During the year ended Nov. 30, 1915, the Widal test was carried out with 2,248 specimens of blood. Of these specimens, 425, or 18.91 per cent., gave a positive reaction. Specimens were sent from 182 cities and towns. These facts are shown in detail in the following table.

Cultural tests designed to demonstrate the presence of typhoid bacilli in the blood, feces and urine of patients, particularly in the excreta of convalescents, were performed with 375 specimens.

Widal Test, Dec. 1, 1914, to Nov. 30, 1915, inclusive.

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	Atypical.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	Atypical.
Abington, ...	1	-	-	1	BEVERLY, ...	22	3	19	-
Acton, ...	1	-	1	-	Blackstone, ...	2	-	2	-
Adams, ...	12	5	6	1	Bolton, ...	2	-	2	-
Amesbury, ...	13	-	13	-	Boston, ...	25	4	19	2
Amherst, ...	9	1	8	-	Bourne, ...	3	1	2	-
Arlington, ...	3	2	-	1	Braintree, ...	15	4	11	-
Ashburnham, . . .	33	12	20	1	Bridgewater, . . .	11	8	3	-
Ashland, ...	4	1	3	-	Brimfield, ...	1	1	-	-
Athol, ...	2	-	2	-	Buckland, ...	2	-	1	1
ATTLEBORO, ...	63	5	58	-	CAMBRIDGE, ...	37	-	37	-
Auburn, ...	6	-	6	-	Canton, ...	23	1	22	-
Ayer, ...	2	1	-	1	Charlton, ...	1	1	-	-
Barnstable, ...	1	-	1	-	Chatham, ...	4	-	4	-
Barre, ...	2	-	2	-	CHELSEA, ...	28	7	19	2
Becket, ...	2	2	-	-	Clarksburg, ...	1	-	1	-
Bedford, ...	1	-	1	-	Cohasset, ...	27	-	26	1
Belchertown, . . .	1	-	1	-	Colrain, ...	2	-	1	1
Belmont, ...	1	-	1	-	Concord, ...	47	1	45	1

Widal Test, Dec. 1, 1914, to Nov. 30, 1915, inclusive — Continued.

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	Atypical.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	Atypical.
Conway, ...	1	-	1	-	Holden, ...	4	1	3	-
Danvers, ...	12	-	11	1	Holliston, ...	1	1	-	-
Dartmouth, ...	3	1	2	-	Hopedale, ...	3	-	3	-
Dedham, ...	2	1	1	-	Hopkinton, ...	4	-	4	-
Deerfield, ...	3	-	3	-	Hubbardston, ...	1	-	1	-
Dennis, ...	6	3	2	1	Hudson, ...	4	3	1	-
Dighton, ...	1	-	1	-	Hull, ...	15	-	15	-
Dover, ...	1	-	1	-	Ipswich, ...	11	-	11	-
Dudley, ...	1	-	1	-	Kingston, ...	2	1	1	-
Duxbury, ...	1	-	1	-	Lancaster, ...	5	1	2	2
East Bridgewater, ...	2	1	1	-	Lee, ...	2	1	1	-
Easthampton, ...	6	2	4	-	Lenox, ...	1	-	1	-
Easton, ...	12	3	9	-	Lexington, ...	35	6	27	2
Edgartown, ...	1	-	1	-	LYNN, ...	240	47	178	15
Essex, ...	1	-	1	-	MALDEN, ...	3	1	2	-
EVERETT, ...	39	7	27	5	Mansfield, ...	139	32	96	11
Fairhaven, ...	1	1	-	-	Marblehead, ...	6	1	5	-
FALL RIVER, ...	2	-	2	-	MARLBOROUGH, ...	23	12	8	3
Falmouth, ...	1	-	1	-	Marshfield, ...	2	-	1	1
Foxborough, ...	20	3	12	5	Mashpee, ...	1	1	-	-
Franklin, ...	3	-	2	1	Maynard, ...	13	4	9	-
Georgetown, ...	1	1	-	-	Medfield, ...	14	2	12	-
GLOUCESTER, ...	20	2	18	-	MEDFORD, ...	40	11	28	1
Goshen, ...	1	-	1	-	Medway, ...	3	-	2	1
Grafton, ...	7	1	6	-	MELROSE, ...	56	9	41	6
Greenfield, ...	11	5	5	1	Methuen, ...	1	1	-	-
Hadley, ...	5	2	3	-	Middleborough, ...	1	-	1	-
Hamilton, ...	1	-	1	-	Middleton, ...	1	1	-	-
Hanover, ...	5	1	4	-	Milford, ...	13	2	11	-
Harwich, ...	8	3	5	-	Milton, ...	5	2	3	-
Hatfield, ...	2	2	-	-	Monson, ...	1	-	1	-
HAYERHILL, ...	1	-	1	-	Nantucket, ...	7	5	2	-
Hingham, ...	9	-	8	1	Natick, ...	17	3	14	-
Holbrook, ...	2	-	2	-	Needham, ...	1	-	1	-

Widal Test, Dec. 1, 1914, to Nov. 30, 1915, inclusive — Continued.

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	Atypical.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	Atypical.
NEW BEDFORD, . . .	4	-	4	-	Saugus, ...	8	1	7	-
New Marlborough, . . .	2	-	1	1	Scituate, ...	5	2	3	-
NEWBURYPORT, . . .	27	4	19	4	Somerset, ...	1	-	1	-
NEWTON, ...	36	8	25	3	SOMERVILLE, ...	5	-	5	-
NORTH ADAMS, . . .	20	2	17	1	South Hadley, ...	2	-	2	-
North Andover, . . .	2	1	1	-	Southbridge, ...	11	2	9	-
North Attleborough, . .	19	2	17	-	Spencer, ...	7	2	4	1
North Brookfield, . . .	1	-	1	-	Sterling, ...	1	-	1	-
North Reading, . . .	7	2	4	1	Stoneham, ...	8	-	8	-
NORTHAMPTON, . . .	28	5	17	6	Stoughton, ...	6	1	5	-
Northbridge, ...	34	12	19	3	Stow, ...	1	-	1	-
Norton, ...	1	1	-	-	Sudbury, ...	1	-	1	-
Norwell, ...	1	-	1	-	Sutton, ...	1	1	-	-
Norwood, ...	9	1	8	-	Swampscott, ...	9	2	7	-
Oak Bluffs, ...	7	1	6	-	TAUNTON, ...	40	9	27	4
Orange, ...	1	-	1	-	Templeton, ...	3	1	2	-
Palmer, ...	5	2	2	1	Tisbury, ...	5	1	4	-
Peabody, ...	21	7	11	3	Tyngsborough, ...	1	-	1	-
PITTSFIELD, ...	32	4	27	1	Wakefield, ...	13	5	7	1
Plainville, ...	2	-	2	-	Walpole, ...	10	-	10	-
Plymouth, ...	1	-	-	1	WALTHAM, ...	114	11	101	2
Princeton, ...	1	-	1	-	Warren, ...	3	-	3	-
Provincetown, ...	12	6	5	1	Watertown, ...	32	3	27	2
QUINCY, ...	81	27	49	5	Wayland, ...	3	-	3	-
Randolph, ...	2	-	2	-	Webster, ...	6	1	5	-
Raynham, ...	2	-	2	-	Wellesley, ...	1	-	1	-
Reading, ...	7	1	6	-	Wellfleet, ...	2	1	1	-
Rehoboth, ...	2	1	1	-	Wendell, ...	2	-	2	-
REVERE, ...	49	9	38	2	West Brookfield, ...	2	-	2	-
Rockland, ...	2	-	2	-	Westfield, ...	51	1	48	2
Rockport, ...	7	2	4	1	Westminster, ...	2	-	2	-
Royalston, ...	1	-	1	-	Weston, ...	1	-	1	-
Russell, ...	1	-	1	-	Westport, ...	3	1	1	1
SALEM, ...	23	8	14	1	Weymouth, ...	17	4	13	-

Widal Test, Dec. 1, 1914, to Nov. 30, 1915, inclusive — Concluded.

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	Atypical.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	Atypical.
Whitman, ...	2	-	2	-	WOBURN, ...	42	7	31	4
Williamsburg, ...	3	-	2	1	WORCESTER, ...	39	8	25	6
Wilmington, ...	1	1	-	-	Wrentham, ...	3	-	3	-
Winchendon, ...	4	4	-	-	Yarmouth, ...	3	-	3	-
Winchester, ...	24	2	21	1	Totals, ...	2,248	425	1,693	130
Winthrop, ...	23	1	22	-					

Cultural Tests for Typhoid Fever, Dec. 1, 1914, to Nov. 30, 1915, inclusive.

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.
Acton, ...	1	-	1	Dover, ...	1	-	1
Ashburnham, ...	6	-	6	Easton, ...	1	1	-
ATTLEBORO, ...	3	-	3	EVERETT, ...	14	1	13
BEVERLY, ...	13	-	13	FALL RIVER, ...	3	-	3
Barnstable, ...	1	-	1	Foxborough, ...	4	1	3
BOSTON, ...	69	4	65	Gardner, ...	8	-	8
Bourne, ...	2	-	2	Grafton, ...	2	1	1
Braintree, ...	5	-	5	Hanover, ...	2	-	2
Brookline, ...	5	-	5	Harwich, ...	3	-	3
CAMBRIDGE, ...	4	-	4	Hingham, ...	2	-	2
Chatham, ...	1	-	1	Hudson, ...	1	-	1
Chelmsford, ...	2	-	2	Hull, ...	3	-	3
CHELSEA, ...	1	-	1	Lancaster, ...	4	-	4
Clinton, ...	9	1	8	Lenox, ...	1	1	-
Cohasset, ...	1	-	1	Lexington, ...	2	-	2
Colrain, ...	1	-	1	LOWELL, ...	1	-	1
Concord, ...	1	-	1	LYNN, ...	12	-	12
Danvers, ...	2	-	2	MALDEN, ...	3	-	3
Dighton, ...	1	-	1	Mansfield, ...	52	9	43

Cultural Tests for Typhoid Fever, Dec. 1, 1914, to Nov. 30, 1915, inclusive —
 Concluded.

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.
Marshfield, ...	2	-	2	REVERE, ...	3	-	3
Maynard, ...	2	-	2	SALEM, ...	7	-	7
Medfield, ...	9	-	9	SOMERVILLE, ...	8	-	8
MEDFORD, ...	7	-	7	Spencer, ...	1	-	1
MELROSE, ...	9	-	9	Tyngsborough, ...	2	-	2
Middleton, ...	1	-	1	Wakefield, ...	4	-	4
Milton, ...	5	-	5	WALTHAM, ...	8	-	8
NEWBURYPORT, ...	10	-	10	Watertown, ...	1	-	1
NEWTON, ...	14	-	14	Wellesley, ...	6	-	6
NORTH ADAMS, ...	3	1	2	Westport, ...	4	-	4
NORTHAMPTON, ...	3	-	3	Winchester, ...	1	-	1
Norton, ...	1	-	1	Winthrop, ...	1	-	1
PITTSFIELD, ...	1	-	1	WOBURN, ...	2	1	1
QUINCY, ...	3	-	3	WORCESTER, ...	6	1	5
Reading, ...	2	1	1	Totals, ...	375	23	352
Rehoboth, ...	2	-	2				

REPORT OF THE STATE DISTRICT HEALTH OFFICERS, OCT. 31, 1914, TO OCT. 31, 1915.¹

INTRODUCTION.

This is the first annual report of the State District Health Officers of Massachusetts. Under the State Department of Health, there have been created by the Commissioner of Health eight health districts, with a State District Health Officer in charge.

The numbers and names of the health districts, cities and towns within same, with the names and addresses of the District Health Officers, follow.

HEALTH DISTRICTS AND STATE DISTRICT HEALTH OFFICERS, APRIL, 1915.

The Southeastern District — No. 1.

Acushnet.	Freetown.	Provincetown.
ATTLEBORO.	Gay Head.	Raynham.
Barnstable.	Gosnold.	Rehoboth.
Berkley.	Harwich.	Rochester.
Bourne.	Kingston.	Sandwich.
Brewster.	Lakeville.	Seekonk.
Carver.	Mansfield.	Somerset.
Chatham.	Marion.	Swansea.
Chilmark.	Mashpee.	TAUNTON.
Dartmouth.	Mattapoisett.	Tisbury.
Dennis.	Middleborough.	Truro.
Dighton.	Nantucket.	Wareham.
Duxbury.	NEW BEDFORD.	Wellfleet.
Eastham.	Norton.	West Tisbury.
Edgartown.	Oak Bluffs.	Westport.
Fairhaven.	Orleans.	Yarmouth.
FALL RIVER.	Plymouth.	
Falmouth.	Plympton.	

Dr. ADAM S. MACKNIGHT, 355 North Main Street, Fall River, *State District Health Officer.*

¹ Edited by Dr. Adam S. MacKnight, District Health Officer, the Southeastern District, and Dr. Charles E. Simpson, District Health Officer, the North Midland District.

The Eastern District — No. 2.

Abington.	Franklin.	Pembroke.
Avon.	Halifax.	Plainville.
Bellingham.	Hanover.	QUINCY.
BOSTON.	Hanson.	Randolph.
Braintree.	Hingham.	Rockland.
Bridgewater.	Holbrook.	Scituate.
BROCKTON.	Hull.	Sharon.
Brookline.	Marshfield.	Stoughton.
CAMBRIDGE.	Medfield.	Walpole.
Canton.	Medway.	West Bridgewater.
Cohasset.	Millis.	Westwood.
Dedham.	Milton.	Weymouth.
Dover.	Norfolk.	Whitman.
East Bridgewater.	North Attleborough.	Wrentham.
Easton.	Norwell.	
Foxborough.	Norwood.	

Dr. MERRILL E. CHAMPION, Wollaston, *State District Health Officer.*

The Northeastern District — No. 3.

Amesbury.	Lynnfield.	Rockport.
BEVERLY.	MALDEN.	Rowley.
Boxford.	Manchester.	SALEM.
CHELSEA.	Marblehead.	Salisbury.
Danvers.	MELROSE.	Saugus.
Essex.	Merrimac.	Stoneham.
EVERETT.	Middleton.	Swampscott.
Georgetown.	Nahant.	Topsfield.
GLOUCESTER.	Newbury.	Wakefield.
Groveland.	NEWBURYPORT.	Wenham.
Hamilton.	North Reading.	West Newbury.
HAVERHILL.	Peabody.	Winthrop.
Ipswich.	Reading.	
LYNN.	REVERE.	

Dr. WILLIAM HALL COON, 92 Main Street, Haverhill, *State District Health Officer.*

The North Midland District — No. 4.

Acton.	Billerica.	Concord.
Andover.	Boxborough.	Dracut.
Arlington.	Burlington.	Dunstable.
Bedford.	Carlisle.	LAWRENCE.
Belmont.	Chelmsford.	Lexington.

The North Midland District — No. 4 — Concluded.

Lincoln.	SOMERVILLE.	Wayland.
Littleton.	Stow.	Westford.
LOWELL.	Sudbury.	Weston.
Maynard.	Tewksbury.	Wilmington.
MEDFORD.	Tyngsborough.	Winchester.
Methuen.	WALTHAM.	WOBURN.
North Andover.	Watertown.	

Dr. CHARLES E. SIMPSON, 100 Holyrood Avenue, Lowell, *State District Health Officer.*

The South Midland District — No. 5.

Ashland.	MARLBOROUGH.	Southborough.
Auburn.	Mendon.	Southbridge.
Blackstone.	Milford.	Spencer.
Brookfield.	Millbury.	Sturbridge.
Charlton.	Natick.	Sutton.
Douglas.	Needham.	Upton.
Dudley.	NEWTON.	Uxbridge.
Framingham.	Northborough.	Warren.
Grafton.	Northbridge.	Webster.
Holliston.	North Brookfield.	Wellesley.
Hopedale.	Oxford.	Westborough.
Hopkinton.	Sherborn.	West Brookfield.
Leicester.	Shrewsbury.	WORCESTER.

Dr. WILLIAM W. WALCOTT, 32 West Central Street, Natick, *State District Health Officer.*

The Wachusett District — No. 6.

Ashburnham.	Harvard.	Phillipston.
Ashby.	Holden.	Princeton.
Athol.	Hubbardston.	Royalston.
Ayer.	Hudson.	Rutland.
Barre.	Lancaster.	Shirley.
Berlin.	Leominster.	Sterling.
Bolton.	Lunenburg.	Templeton.
Boylston.	New Braintree.	Townsend.
Clinton.	New Salem.	Warwick.
Dana.	Oakham.	West Boylston.
FITCHBURG.	Orange.	Westminster.
Gardner.	Paxton.	Winchendon.
Groton.	Pepperell.	
Hardwick.	Petersham.	

Dr. LEWIS FISH, 86 Day Street, Fitchburg, *State District Health Officer.*

The Connecticut Valley District — No. 7.

Agawam.	Hadley.	Shutesbury.
Amherst.	Hampden.	Southampton.
Belchertown.	Hatfield.	South Hadley.
Blandford.	Holland.	Southwick.
Brimfield.	HOLYOKE.	SPRINGFIELD.
Chesterfield.	Huntington.	Sunderland.
CHICOPEE.	Leverett.	Tolland.
Conway.	Longmeadow.	Wales.
Deerfield.	Ludlow.	Ware.
Easthampton.	Monson.	Westfield.
East Longmeadow.	Montgomery.	Westhampton.
Enfield.	NORTHAMPTON.	West Springfield.
Goshen.	Palmer.	Whately.
Granby.	Pelham.	Wilbraham.
Granville.	Prescott.	Williamsburg.
Greenwich.	Russell.	

Dr. JOHN S. HITCHCOCK, 160 Main Street, Northampton, *State District Health Officer.*

The Berkshire District — No. 8.

Adams.	Greenfield.	Otis.
Alford.	Hancock.	Peru.
Ashfield.	Hawley.	PITTSFIELD.
Becket.	Heath.	Plainfield.
Bernardston.	Hinsdale.	Richmond.
Buckland.	Lanesborough.	Rowe.
Charlemont.	Lee.	Sandisfield.
Cheshire.	Lenox.	Savoy.
Chester.	Leyden.	Sheffield.
Clarksburg.	Middlefield.	Shelburne.
Colrain.	Monroe.	Stockbridge.
Cummingtown.	Montague.	Tyringham.
Dalton.	Monterey.	Washington.
Egremont.	Mount Washington.	Wendell.
Erving.	New Ashford.	West Stockbridge.
Florida.	New Marlborough.	Williamstown.
Gill.	NORTH ADAMS.	Windsor.
Great Barrington.	Northfield.	Worthington.

Dr. LYMAN A. JONES, 163 Pleasant Street, North Adams, *State District Health Officer.*

BOARDS OF HEALTH.

One of the most important functions of the work of the State District Health Officer is his relation to the different boards of health. He cannot personally attend to the details throughout the district, but must depend on the local boards. Some boards show special efficiency in one line, some in another, occasionally one in practically all directions. Many of them show marked inefficiency and do little more than the necessary clerical work. This is not so much the fault of the personnel as it is the fault of the system by which these offices are filled. The methods of selection have much to do with the perpetuation of inefficiency in office. Too often it is the local politician who is elected, rather than the local health authority.

The laws of Pennsylvania require each borough to have a health officer, while those of New York require each town to have one. If we could have some such requirement in Massachusetts, so that each town or small group of towns should be required to have a qualified health officer, it would simplify the work very much and insure those communities much better health service.

In Massachusetts, regardless of the size of a town, it is optional with the people of that town whether it shall have a separate board of health or whether it shall leave its health measures to the selectmen, none of whom need have any qualifications for the office of health officer, and usually is free to admit it. If the town does have a separate board and has a population of more than 5,000, one of the members must be a physician.

Number of towns, with population less than 5,000, having separate boards of health, ...	61
Number of towns, with population more than 5,000, not having separate boards of health, ...	5
Number of towns, with population more than 10,000, not having separate boards of health, ...	2

DISEASES DANGEROUS TO THE PUBLIC HEALTH.

From the comparative district tables of the communicable diseases for several years past, it would be reasonable to assume that the constant efforts to secure better health by the health officers in the districts were beginning to bear fruit. The gain of added funds for health work, the employment of agents and nurses, the extension of water mains and sewers, the gradually increasing practice of investi-

gating cases of communicable disease, when first reported, and educational work done, have surely had a very real influence, though it is not always easily estimated. The increasing activity of local boards and their co-operation have been of the greatest importance.

Diphtheria, scarlet fever and typhoid fever are probably quite fully reported. Other communicable diseases are gaining as to reporting, though there are undoubtedly many cases which escape the knowledge of the health authorities. This is particularly true of whooping cough, measles, chicken pox and mumps, some of which have been more recently added to the reportable list.

A continued well-planned campaign of publicity in local newspapers would doubtless go far toward securing fuller reports of the so-called minor infectious diseases.

Though it is admitted that the co-operation of the local boards of health has been greatly improved, there is still much more to do along these lines. Too often the activity is that of one member. There is, in consequence, a lack of unity in local health work, and the diseases that endanger the community, unfortunately, get a foothold and collect their usual toll of death or disability. We need to have our State District Health Officer endowed with more than mere advisory authority under such circumstances. Here is where the dangerous disease problem needs probing. Something must be done to protect the well from the sick, and vice versa. Nothing short of a trained local health officer will meet such issues, and special legislation, so providing, should be set in motion.

The figures that are used in this report are for the fiscal year October 31 to October 31, not January to January as is the time for the official figures, consequently they will not coincide.

ANTHRAX.

Ten cases have been reported with one death. This is so ridiculously small a death rate that it suggests cases reported without laboratory findings. With the facilities furnished for laboratory diagnosis by the State, as well as many of the larger cities, it would seem that there was little excuse for this. In many cases, whatever the disease, it will be advisable to report the case and commence treatment on a clinical diagnosis, but there are few instances where this should not be confirmed in the increasingly large number of diseases where the laboratories are prepared to do such work. It is due the patient as well as the statistician. Neither the physician nor the health officer can give a disease its true significance without reasonably accurate statistics.

The tanneries claim that, owing to the war, it is hard for them to obtain hides through the usual channels, and that many they are receiving now from foreign ports are not in as good condition as the ones they usually handle.

Cases have been reported from Boston, Fall River, Springfield, Winchester and Woburn. So far as we know, the serum for this disease has not been used in Massachusetts. If the diagnosis were correct, possibly the type of the disease may have had something to do with the low fatality.

ANTERIOR POLIOMYELITIS.

The total number of cases reported for the year numbered 121 with 18 deaths. In one district 5 cases of the disease were reported in one city. The cases did not develop at one time, but were distributed over the year, and in different localities. These cases showed no evidence of contact, nor was the source of infection determined.

In another district 13 cases were reported from nine localities. Four of these cases were fatal. In no instance could any connection with a previous case be traced. In one case the only opportunity for contact with people away from its own home was at a county fair, where this particular child took the "blue ribbon" as the most healthy baby exhibited. This was two weeks before the disease developed.

In one case a paralyzed hen was found on the premises. For six months of the year not another case developed within this district.

In another district, although individual cases occurred in various parts of the district, there were fewer cases than usual. Two interesting cases were investigated in one town within this district, between the last of one month and the first of the next month. These cases showed the most probable contact infection thus far noted. These cases were related as cousins, and they lived but a short distance apart. There seemed to be no clue which would lead to a reason for the occurrence of the first case, which was taken ill the beginning of the last week of school attendance, felt a little better, did not go to school the following Monday, Tuesday and Wednesday, but returned to school Thursday and Friday, was much worse Saturday, and the paralysis was most pronounced on the Sunday following. During this time, the days that this first case was out of school, he spent in playing with his young cousin who had not yet started to attend school. This young cousin had a similar train of prodromal symptoms followed by paralysis about ten days later than his cousin of the first case. The first case had considerable nasal discharge. There were,

however, other children in the families of both cousins, none of whom showed any signs of departure from normal health.

In another district but 7 cases developed during the year. One city with a population over 100,000 reported but 2 cases. Another city with a population over 95,000 also reported 2 cases. Three cases were reported from 3 towns, while the remaining 61 towns reported none. As compared with the number of cases reported in this district during the preceding year, the decrease was 16.

The number of cases throughout the State has been decidedly less than in 1914. The two-year periodicity noted so strikingly in some places has not shown up as in the past few years.

VARICELLA.

The number of cases reported for the year was 5,638. This disease is ordinarily of interest to the health officer only in that light cases of smallpox are so frequently taken for it. This was exemplified in Spencer this year.

No State District Health Officer rests easy when he finds reports of chicken pox coming in from any section, especially if there are deaths, until he has seen a case or two and satisfied himself that it is the lesser disease.

If physicians would only familiarize themselves with the appearance of smallpox, whenever they have an opportunity, there would be fewer epidemics of that disease well under way before it is recognized. The District Health Officers should be consulted in doubtful cases, and the diagnosis determined.

The report of the 20 deaths from varicella during the year seemed to indicate a mistake in diagnosis, or a clerical error by some board of health clerk in recording some other disease in the varicella column. Investigation revealed the fact that 12 of these deaths were reported as a result of clerical errors, — 2 should have been attributed to other causes, — while the death certificates from the remainder read varicella alone and could not be further verified.

EPIDEMIC CEREBROSPINAL MENINGITIS.

There have been 156 cases of this disease during the year, with 100 deaths or about 64 per cent. fatality rate. There has been no extensive epidemic reported, but a few cases being found in one locality. Although the Flexner serum is being generally used, the death rate is still very high.

The laboratory in this, as in most other diseases, is not used for

diagnostic purposes as frequently as it ought to be. It is probable that many deaths recorded as epidemic cerebro-spinal meningitis are concurrent with other diseases, and due to the presence of other bacteria. Notwithstanding this, a few cases that have been carefully watched, diagnosis confirmed by laboratory examination, and anti-serum given early, have still shown a large case death rate.

DIPHTHERIA.

The total number of cases of this disease reported during the year was 9,281. The total number of deaths during the same period was 607. The fatality rate was 6.5 per cent, which is not unusually high for this disease.

Special investigations, carried on by the State District Health Officers, show that the principal etiological factors in the spread of this disease have been contacts, carriers and infected milk. The several reports of the State District Health Officers give the essential data in support of this statement. They are as follows:—

In the Wachusett Health District diphtheria began to increase in prevalence in Fitchburg in September, 1915. From September 1 to October 27, 147 cases were reported. The distribution has been largely in the West and Water streets sections. During the outbreak school physicians have been required to inspect immediately and keep under observation schools wherein cases have occurred, culturing all suspicious throats. All absentees from school from whatever cause have been looked up. Two successive negative release cultures were required before release from quarantine. The outbreak has again demonstrated the serious need of an isolation hospital. Frequent conferences were held with the local health authority relative to methods of procedure against the spread of the disease, with the desired results.

In December, 1914, an outbreak of 10 cases was investigated in Gardner. Proper precautions were exercised by the local health authority, and the disease was controlled.

In June 2 cases were investigated in Shirley, occurring among the inmates of the industrial school located there. They were properly isolated, and no further cases occurred until August 30, when two more were taken ill in another building. The physician then gave 500 units of antitoxin to each of the other inmates of the building, and cultured, hoping in this way to check its spread. Five more cases occurred within twelve days after immunization, and 2 more within another week. The Schick test was given, upon the District Health

Officer's suggestion, and 17 out of 59 boys, who had been previously immunized, gave a positive reaction. These were then given 1,000 units each. Several cases have since been reported in another building.

During October, 1915, an outbreak of 31 cases occurred in Hudson. They occurred largely among school children giving a history of contact. The schools had been closed, but, upon the suggestion of the State District Health Officer, they were reopened, and close medical supervision instituted. Two successive negative cultures were advised before release from quarantine.

Two cases were investigated in Royalston in October. Recommendations were given relative to the reopening of the public school, which had been closed, because of one having attended the school.

Fifteen deaths from diphtheria in 1914 have been investigated, reports of which are on file in the office.

In the North Midland Health District there have been no serious epidemics of diphtheria, but there have been a number of cases in various cities and towns.

In March there were an unusual number in Andover. They were contact cases coming from two foci: one was in the academy, and cases were quickly isolated in the infirmary; the other was at Fryes village, and while the board of health was leaving the quarantine and family isolation practically to the physicians, they seemed to be taking unusually good care of that part of the work.

In May a school outbreak threatened the Pleasant Valley section of Methuen. There was a conference of the school and health authorities with the District Health Officer, and there were only a limited number of cases.

Lawrence has been having more than its quota of cases for the past two years. This was partly due to the lack of an isolation hospital and to the method of terminating quarantine. The board is now insisting on two release cultures, the last to be taken by the physician of the board. This has met with some opposition, but the fact that of the first 8 cultures so taken 5 were positive, has convinced the board that such a step was advisable.

Much of the territory assigned for the survey of deaths from diphtheria in 1914 has not been covered. If that made in Lowell is any criterion, a very large proportion of the deaths may be attributed directly to the family not realizing the seriousness of the disease until too late. Of 23 deaths investigated, when case was reported 4 patients were dead; 8 died the same day; 6 lived but one day after; 1 lived one or two days; 1 lived seven days; 1 lived nine days; 1 lived ten days; 1 lived twelve days. The records showed that the physicians recognized and reported the cases quickly.

The Lowell annual report for 1914 gives 154 cases reported and 26 deaths, 2 of which were out-of-town cases and occurred in the hospital where they had been taken for treatment, leaving 24 for the cases that were contracted in Lowell. If we deduct the 18 that evidently called the physician too late to expect any treatment to be of avail, we will have 6. deaths in 136 cases, — a fatality of 4.41 per cent. Not a bad showing for antitoxin when used early.

In the Connecticut Valley Health District a total of 467 cases was reported for this year. Seven outbreaks were investigated, 5 of these being school outbreaks. In these, the institution of proper diagnostic work, and the exclusion of suspects until they were proven free from the disease, terminated the outbreak.

This disease appears to be endemic in Chicopee and Springfield. In each of these cities there must be a large number of diphtheria carriers. No outbreak was found to be due to infected milk.

In the Southeastern Health District the diphtheria campaign work was fruitful in establishing the shortage and small doses of antitoxin used, as well as the tardy use of same, compared with the rapid progress and late recognition of the disease.

In this district 499 cases of this disease were reported during the year. This disease shows a decrease of 39 cases compared with the number reported for 1914. The greatest number of cases, 163, were reported from Fall River, and 145 from New Bedford, while 32 towns out of 64 are responsible for the reporting of 148 cases.

There has been more frequent use of laboratory aids in the diagnosis of this disease, consequently a more definite reporting of same. It is to be regretted, however, that larger doses of antitoxin are not given in the earlier stages of the disease. It is also to be regretted that there is not a uniform system of determining the release of cases, such as a requirement of two negative cultures within a definite period of time.

In the Berkshire Health District there were 95 cases in 2 cities and 15 towns. A comparison with former years in the old health district is especially favorable as appears from the following table: —

1911-12, ...	302
1912-13, ...	173
1913-14, ...	163
1914-15, ...	63

Of the 95 cases during the year, 80 per cent. occurred in Pittsfield (21), North Adams (18), Montague (15), Adams (13) and Greenfield (8).

The number of cases in Pittsfield (21) shows a marked decrease as compared with the preceding year when there were 61. In 1914 Pittsfield had 49 per cent. of all cases in the district, while this year, compared with the same territory, it had but 32 per cent. of the cases.

A case of diphtheria in the family of a milk peddler was investigated in Pittsfield. Other arrangements were made for the distribution of the milk, and there was no spread of the disease.

The local board of health was advised concerning a case of diphtheria in Northfield, and assistance was given the Leyden board of health concerning 5 cases of the disease in an isolated section of the town.

In the South Midland Health District the following table shows the outbreaks investigated and herein summarized: —

DISEASE.	Town.	Date.
Diphtheria, ...	Brockton, ...	November, 1914
Diphtheria, ...	Framingham, ...	September, 1915
Diphtheria, ...	Needham, ...	August, 1915
Diphtheria, ...	Wellesley, ...	August, 1915

Four special outbreaks worthy of note are briefly summarized as follows: —

BROCKTON.

In the month of November, 1914, 28 cases were reported, and during this month 442 cultures were examined at the local laboratory.

Four cases were reported from the South School, and on November 27, 83 cultures were taken here, *i.e.*, from the janitor, teachers and every pupil. One positive culture was returned in a "carrier case" who has no clinical symptoms but was quarantined several weeks, during which time many positive cultures were obtained by the board of health physician; the child was allowed to return to school only after said official had secured two negative cultures, forty-eight hours apart.

On the day the carrier was detected, the school was fumigated, and desks, floors and hooks upon which clothing was hung were thoroughly cleansed and scrubbed with creolin. The other cases reported during this month were scattered and for the most part among school children.

The school physicians and nurses daily examined every school child, and every one with a suspicious throat or history was excluded and not allowed to return until one negative culture had been obtained.

Positive diphtheria cases are allowed to return to school only after two negative cultures have been obtained. In this follow-up work, in the two weeks ending December 14, 14 positive cultures were received from 227 specimens examined at the laboratory of the local board of health. The local board, with its physicians, agent, school physicians and school nurses, kept the cases, the suspicious cases as well as those who had been exposed, under constant daily supervision, and the local laboratory gave prompt attention to the cultures received, with satisfactory results.

A later outbreak which could not be definitely localized occurred in Holbrook and Brockton during the middle of September, 1915. Thirty cases of sore throat were discovered in Holbrook on the milk route of one Mr. B. At least 16 of these were cases of diphtheria. The neighboring part of Brockton had 11 cases of diphtheria apparently traceable to this milk supply. Investigation of the household uncovered the fact that it contained 5 diphtheria carriers. The trouble apparently started with one boy who ordinarily worked in a shoe factory, but who remained at home a few days because of a mild sore throat.

NEEDHAM.

During the month of August, 1915, 8 cases were reported in Needham. The dates of onset in this particular outbreak give a better idea of the situation because of the delay of foreigners in calling a physician.

These cases were all in the Polish settlement, Highland Avenue. Most of the adults of these families were employed in the Saco silk mills, and the mill physician, as well as attending physician of most of the cases, co-operated with the local authorities and saw to it in every instance that exposed members of the family were cultured, received antitoxin, and adequate quarantine maintained.

The local authorities, as in the Framingham outbreak, instituted a school and house to house culture canvass, but no "carriers" or additional cases were detected.

WELLESLEY.

There were reported in the month of August, 1915, 6 cases which may be divided into two groups as follows:—

Group A.—Three cases. This group of cases was near the Newton line at Newton Upper Falls.

Group B.—Three cases. This group of cases was near Wellesley Village and was not associated with the other group either directly or indirectly.

The family head of group A was a milk producer; four cows gave twenty-two quarts of milk, all of which was peddled in Wellesley in his own neighborhood. The milk was produced and handled under satisfactory conditions, and no other cases occurred on this supply. Beginning August 21 this supply was daily pasteurized by the Wellesley local authorities. One of group A who was visiting the milk producer's family gave a history of having had diphtheria three times before, and was at one time confined with it for six months in the Newton Hospital. At this time he was removed to the Newton Hospital and kept under observation until the necessary negative cultures had been obtained.

FRAMINGHAM.

During the month of September, 1915, 23 cases were reported or detected by the local physicians and agents and physicians of the local board of health. These cases were of a mild, clinical type and in only a few instances was the family physician called on this account. The cases were distributed geographically on the north side of the Boston & Albany tracks, near the factory of the Dennison Manufacturing Company, and those of school age attended a school in this district, while 3 were employed by the Dennison Manufacturing Company.

The school physician and nurse kept the school under daily supervision, and cultures were taken from all suspicious cases, as well as from all cases in any schoolroom where a case was detected. Cultures were also taken from the infected households, and a house to house culture canvass was instituted by the agent of the local board. This culture work resulted in the detection of 3 "carriers," — one a school child, one a baker and one an employee of the Dennison Manufacturing Company. These 3 "carriers" were isolated in one house, and kept under supervision until two successive negative cultures, twenty-four hours apart, had been obtained by the agent of the local board of health.

In this neighborhood considerable home work, such as stringing tags, is done for the Dennison Company, and arrangements were made to have all of these materials destroyed by fire.

Through co-operation between this company, its nurse and the local board of health, arrangements were made so that no employee having the disease, or who had been exposed to it, could return to work without a certificate from the board of health. Under these conditions the outbreak was soon well in hand.

A glance at the diphtheria death rate in the State since 1882, when

it was 97 per 100,000, shows as follows: in 1889 it reached 102. With the introduction of the antitoxin treatment it has dropped in irregular curves till in 1915 it has reached to 16.6 per 100,000. In 1912 it was about 14, the lowest point. This is a good record. It shows a great saving of life for 1914, yet it is not as good as we would wish, for during the last ten years there has been a drop from 22 to 16. The reduction during last year was not at the same ratio as in former years. Increased efforts must be put forth to make a still further reduction.

A campaign of education should be waged, and what few places there are remaining that do not do good work in investigating cases, making use of laboratory aids and careful quarantine, should be urged to do so. Many cases are lost among the poor because they do not feel able to call a physician for every sore throat, and are not able themselves to detect the serious one in time. If we can have more uniformly good medical inspection of schools, and better registration of histories of contagious diseases and family statistics among the scholars, we think it would be a great aid.

From the knowledge we have of its mode of transmission, methods for control and treatment, we think the disease should be stamped out faster. Too much lethargy exists among local officials and the public. They consider a normal amount of diphtheria as a necessity. They are not trying to reach the ideal of Pasteur and stamp out the disease entirely. The State District Health Officers have been making an intensive study of all cases of diphtheria that died in 1914, with the idea of possibly determining the factors responsible for the cause of the deadlock in our fight against this disease. While the investigation has not yet been completed for the whole State, there has already been sufficient work to show that it is due to various causes. Parents are not sufficiently alive to the fact that any sore throat may be diphtheria, and too often do not call a physician until the case is far advanced, perhaps moribund. When a physician is called, not all realize that every sore throat should be cultured. Again, when clinical symptoms of diphtheria are present, he should not be satisfied that the case is not diphtheria because he has a negative culture.

A few have died from loss of time on this account, and quarantine is not enforced. At other times the physicians have not given antitoxin early enough or in sufficiently large doses.

GLANDERS.

Three cases of this disease were reported during the year. One of these was on a milk farm that sends its whole supply to a well-regulated dairy. Owing to the man having been attended until near death by a Christian Scientist, the nature of the disease was nearly missed. Quick work by the State District Health Officer and able co-operation by the veterinarian of the dairy firm confirmed the diagnosis, and lead to the discovery and ridding the farm of the offending horse. This case was in Marlborough, and he undoubtedly contracted it from his own horse. Two cases were reported from Boston. Of these we were unable to learn the end results or histories.

INFECTIOUS DISEASES OF THE EYE.

Under this classification are included the three notifiable diseases, namely, ophthalmia neonatorum, suppurative conjunctivitis and trachoma.

The total number of cases reported during the year is as follows: —

DISEASE.	Cases.	Deaths.
Ophthalmia neonatorum, ...	2,731	—
Suppurative conjunctivitis, ...	161	—
Trachoma, ...	50	—

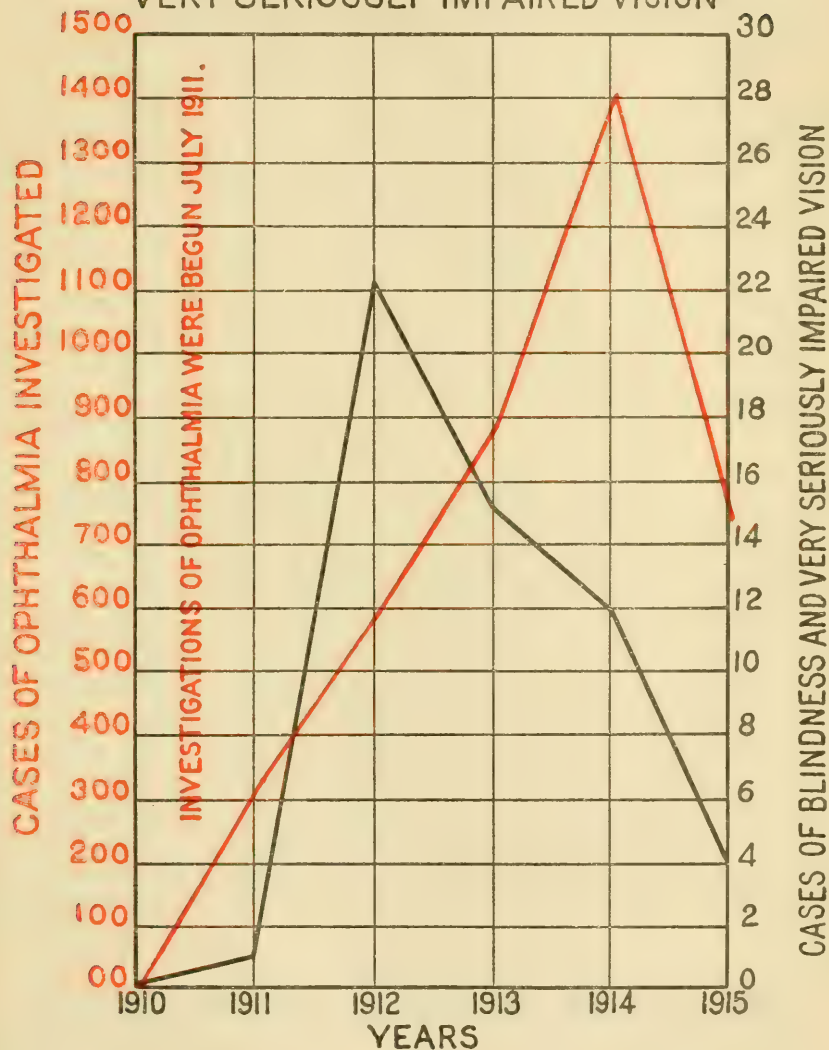
As compared with the number reported and investigated in 1914, it will be found that there has been a decrease of 650 cases, or practically 46 per cent. (see chart).

The State District Health Officers have investigated, personally or otherwise, all of these cases. While a certain relatively small percentage of these cases show some visual impairment, defect or deformity, comparatively few suffer the total loss of vision or blindness.

There are other cases where the end results would seem to indicate permanent loss of vision, but where the final sentence confirming this is still *sub judice*.

Some cases of this disease have left the jurisdiction of the State, but have been followed up and treated in other states and countries, *e.g.*, New York, Rhode Island and Canada, but the case end results of these have not been forthcoming.

DIAGRAM SHOWING
CASES OF BLINDNESS AND
VERY SERIOUSLY IMPAIRED VISION



The educational work of the State District Health Officers, through the investigations made, has resulted in a better system of reporting; the more general use of the prophylactic; the assignment and appointment of oculists; the employment of nurses to care for and follow up the cases; and better co-operation between city or town clerks and boards of health in birth reporting within the statutory period of time. This had had more to do with the preservation of sight than the remedial measures adopted.

Of 203 cases of suppurative conjunctivitis, 103, or more than 50 per cent., have been reported from one of the health districts. In one city the cases of this disease assumed a numerical prominence of 79 for 1915 as compared with 1 for 1914. The reason is obvious, *e.g.*, the number of ophthalmia neonatorum cases reported from that city fell to 71, less than 50 per cent. It is evident that this city is trying to dispose of the old stigma attached to the use of the name "ophthalmia neonatorum." The State some time ago tried to bring this about by quoting the definition of ophthalmia neonatorum as given in Rosenau's recent book on "Hygiene and Preventive Medicine," to which reference may be made.

There is a marked improvement in the action of local health authorities regarding the supervision of these diseases. Those in the city and larger towns are quite active in this respect. Some, however, find excuses for not making investigations at first hand, depending entirely upon statements from the attending physician. It is obvious that when physicians do not follow up their cases closely that serious damage to vision may result. District nurses, present in so many of the smaller towns, as well as in the larger ones, may and do act as a check upon the possible end results by their daily visits to mother and child, and reporting conditions which appear to be unfavorable.

So long as bacteriological examinations are not made when these cases are reported, being the exception rather than the rule, no index of the factors responsible for this disease can be determined. That the number chargeable to gonorrhœal infection is small, must be admitted.

MALARIA.

A total of 106 cases of this disease were reported during the year, with no deaths.

One District Health Officer reports 5 cases from his district this year, and says that this represents but a small part of the number of cases of this disease present, and this means that the physicians are not accustomed to reporting cases of this disease.

On the other hand, another District Health Officer reports but 4 cases, 1 case occurring in a city of 100,000 population, 1 case in a city of 35,000 population, and 2 cases in two small towns, and is rather skeptical as to the correct diagnosis in even this number. As this disease is marked by a variety of symptoms, common to a number of other diseases, it would seem easy in the absence of definite signs for physicians to resort to the use of the blood tests for the *Plasmodium malariae*, especially during the paroxysmal stage of the disease, if in doubt.

In conclusion, although there were 106 cases of malaria reported, and possibly many more occurred that were not reported, as it is one of those diseases that has recently been put on the list, the fact remains that there were no deaths reported. We have the consolation that, while we admit there are still a few malarious districts in our State, we do not have the disease in the intensive forms noted in the south and middle west. It is fair to assume also that imported cases of this disease are with us from other sections of the country where they were recognized, and that such cases are not reported as this class are not permanent residents of the State, or have learned how to treat the disease themselves as well as recognize the symptoms.

Knowing the cause of malaria as well as we do, and that it has been controlled in districts where the particular species of mosquito is more prevalent than it is in Massachusetts, should be an incentive to us to try to stamp it out. Places infected with the disease should try to drain their swampy grounds and have the houses thoroughly screened with screening that is sufficiently fine to keep the mosquito out. In order to accomplish these things, the public should co-operate with the local officials.

MEASLES.

The total number of cases reported for the year was 22,265, with 144 deaths or 0.6 per cent. Measles have been reported as epidemic in some part of nearly all the districts.

Some cities and towns do very little to control this disease and most of them consider the task hopeless. There are several factors that lead to this. Public opinion very much underestimates the seriousness of the disease, so that they frequently neither call a physician, report the case themselves, nor give the patient adequate care. Physicians have been found, either through ignorance in distinguishing between primary and secondary cause of death, or fear of loss of prestige in losing a case of measles, who will sign the death return by some of the common sequelæ of measles rather than the true cause.

In one city 4 cases that had died in one week were investigated

by the District Health Officer. All had been properly reported, but only one death return gave measles as the primary cause of death.

Another cause of failure is the great contagiousness in the prodromal stage, when even the parents may not know the child is sick. The committee of the Massachusetts Association of Boards of Health are considering the suggestion advanced by the District Health Officer of the Berkshire District in his 1914 report. If it is adopted and carried out in several places, the results will be worth watching, especially if combined with an improved school inspection. The plan is to quarantine all children exposed who have not had the disease, commencing quarantine ten days after the first exposure.

A large number of cases of measles were reported by the families in Waltham after an article had been printed in the local papers explaining that the State law required such reports.

The opinion of most health authorities is well summed up in the report of the District Health Officer of the Connecticut Valley District. "Epidemiological work in this disease has not given any appreciable results. In Springfield an inspector was sent to each case immediately on receipt of the notice, the family were given directions for care, and a later visit was made to see how well these directions were being carried out. This apparently made no difference with the incidence rate of the disease, and it finally disappeared after most of the non-immunes had been infected."

The seriousness of the disease is such that instead of throwing up one's hands because the old methods fail, we should all join in finding a satisfactory method for controlling this disease.

The South Midland District is noticeable in reporting that there has been but one outbreak in the district during the year. That was in one town and consisted of 59 cases, all but three or four being attendants at one school.

The exposure, however, of children to avoidable diseases is absolutely criminal, whether done by parents or other agencies. Something should be done to stop the crippling and slaughter of these "innocents." It is a terrible arraignment of human intelligence when we are told that "they (the children) ought to have these diseases while young and so escape the same diseases in later life." Persons making such statements to-day are fit subjects for psychopathic hospitals, and their final sentence should consign them to certain asylums. Such persons are a menace to childhood and dangerous to the public health. Every child is entitled to health and happiness. He should not be exposed at all to any disease, communicable or otherwise. Hence more stringent health laws for the protection of children, home, school or elsewhere, are demanded of the Legislature.

PELLAGRA.

Fifteen cases of this disease were reported in the State during the year. Eight of these were inmates of public institutions and one out on parole from an asylum.

Some are inclined to consider it an institution disease, but so far as Massachusetts cases go it would not seem to be due to the fault of the diet in any institution, as the cases have usually been found in institutions where the stay is comparatively short rather than in those that keep them for a longer time.

That it is due in all probability to the lack of a well-balanced diet is being demonstrated by the experiments of Goldberger and others in the United States Public Health Service.

That some cases are probably overlooked is shown in those investigated, as some of them have gone through the hands of several physicians before the true nature of the disease was determined. With the comparatively few number of cases it is not to be wondered at. More nitrogenous foods are indicated in the treatment. That meats are so much more expensive may be the cause of the increasing number of cases found.

This disease has been located in four of the eight districts: North-eastern, North Midland, Connecticut Valley and Wachusett. Although the disease is on the increase as reported in Massachusetts, the fact that it is clearly shown by the United States government researches that the disease is due to a poorly balanced diet, makes us believe that we need not be alarmed concerning it. Education of the people as to the relative amounts of nitrogenous and other foods required should be sufficient to suppress it.

RABIES AND DOG-BITE.

It was fortunate for many people in Massachusetts that, just before the epidemic of rabies among the dogs in the eastern and central portion of the State developed, the State Department of Health had made arrangements to furnish free antirabic treatment to those who needed it and wished it. Aug. 25, 1914, a circular was sent to the local boards of health offering the treatment as stated in the 1914 report.

With the rapid increase of the cases shown in the early part of this year, several of the State District Health Officers found themselves much in the position of one, who says: "An undue proportion of time was spent upon ophthalmia work and the treatment of dog-bite

cases. Numerous cases requiring the Pasteur treatment were reported, widely distributed geographically. It was not uncommon for weeks at a time that entire days were spent traveling about to give this treatment, and it was not until it became generally understood that patients requiring treatment must go to the District Health Officer that this waste of time was prevented."

Recognizing this condition, a notice was sent to all local boards of health May 10, 1915, advising them that they could procure virus and treat their own patients, or make arrangements to send them to the State District Health Officer at any place most convenient for him.

A very few cases have been treated by their family physician, a few cities and towns have treated cases at their own expense, but by far the larger number have been treated by the State.

There were 96 cases given antirabic treatment by or under the direction of the State District Health Officers, 28 were treated by local physicians, and 11 cases that were bitten by dogs, that the laboratory reported to be suffering from rabies, received no treatment. Five cases developed rabies and died. One of these had taken antirabic treatment. No constitutional disturbances followed the treatment. In 2 cases there were abscesses that were opened. The incubation period follows:—

One case in Peabody was bitten on the face February 20. No treatment other than local. Symptoms developed March 11, making 19 days.

One case in Medford was bitten on the leg through the stocking on June 7. Local treatment only. Symptoms developed August 5, making 59 days.

One case in Haverhill was bitten on the finger January 4. No treatment. Symptoms developed February 17, making 44 days.

One case in Lawrence died of what seemed to be rabies, although no autopsy or laboratory test was made. Bitten under suspicious circumstances four years previously.

One case in Peabody was bitten on the face 258 days previously by dog of first case. Treated locally and after a delay of 21 days was given antirabic treatment. Developed some form of meningitis which was reported as rabies, but in this diagnosis the State District Health Officer did not concur.

One case in Holden bitten Sept. 5, 1914, treated the wound himself, developed symptoms of rabies Jan. 18, 1915, and died a few days later. Period of incubation, 135 days.

The following table shows the number treated by the State District Health Officers and their residence:—

Acton, ...	1	Medford, ...	1
Arlington, ...	3	Newton, ...	3
Barre, ...	1	North Attleborough, ...	1
Beverly, ...	1	Northborough, ...	1
Billerica, ...	2	Norton, ...	2
Boylston, ...	1	Norwood, ...	1
Chelmsford, ...	1	Peabody, ...	2
Danvers, ...	1	Princeton, ...	2
Enfield, ...	1	Rutland, ...	1
Fall River, ...	2	Salem, ...	6
Fitchburg, ...	2	Somerville, ...	4
Gloucester, ...	4	Sterling, ...	1
Groveland, ...	3	Tewksbury, ...	2
Haverhill, ...	11	Tyngsborough, ...	1
Holden, ...	2	Waltham, ...	7
Lawrence, ...	4	Wayland, ...	1
Leominster, ...	3	Wellesley, ...	1
Lexington, ...	1	West Newbury, ...	4
Lowell, ...	1	Weston, ...	2
Lynn, ...	1	Westport, ...	1
Lynnfield, ...	1	Woburn, ...	1
Marlborough, ...	2		
Mattapoisett, ...	1	Total, ...	96
Maynard, ...	1		

The following table shows the number of cases treated by local authorities or private physicians as follows:—

Attleboro, ...	3	Quincy, ...	2
Belmont, ...	1	Revere, ...	1
Boston, ...	3	Seekonk, ...	1
Cambridge, ...	3	Southbridge, ...	1
Chelsea, ...	2	Springfield, ...	2
Chicopee, ...	1	Wakefield, ...	2
Dorchester, ...	1	Waltham, ¹	1
Gloucester, ...	2	Westfield, ...	2
Hatfield, ...	1	Weymouth, ...	2
Lawrence, ...	1	Winthrop, ...	4
Lynn, ...	1	Worcester, ...	18
Millbury, ...	1		
Newton, ...	3	Total, ...	59

Considering the fact that the Federal Public Health Service has been able to gather statistics showing that about 1 case in 6 bitten by a rabid dog will have rabies if not treated, and that 1 in 200 die

¹ Treated in New Hampshire.

who have been given the antirabic treatment, all that have rabies die, and that in a series of 217,774 cases 100 of them had paralysis, many of which were fatal, it is a choice of evils.

It is evident from these figures that prevention is better than the cure. The work done in England shows that rabies was effectually stamped out in two years where they were able to control and muzzle all dogs. Five people are reported to have died of rabies in Massachusetts within a year. True this is not many compared with other diseases, but may it not be worth the effort of some investigator who is not putting all his time in other problems?

We could not as a State do what they have done in England owing to our surrounding States and countries. The problem probably could not be solved in this way as a nation, but perhaps it can in another way. It has been shown that dogs can be immunized against rabies, but so far not in a way that would be practical on a large scale. If it could be done with three injections as typhoid immunization is now done, it would be practical, and then we see no reason why dogs and dog owners should not bear the burden rather than victims of bites of rabid animals. Allow no one to license a dog that is not immunized.

SCARLET FEVER.

The total number of cases of this disease reported was 8,499, with 207 deaths, or a case death rate of 2.3 per cent.

In the Connecticut Valley Health District there were 519 cases reported from 23 localities, the hill towns being mostly free from it.

In Holyoke there were 205 cases. It appeared throughout the year, no month being free from it. The outbreaks throughout the district were investigated and none of them was found to be due to milk.

The Berkshire District Health Officer reports that there has been a gratifying decrease in scarlet fever as compared with former years. A total of 116 cases was reported from 2 cities and 14 towns. Seventy-five per cent of the cases occurred as follows: Pittsfield (44), Adams (17), Greenfield (17) and North Adams (10). A total of 17 cases was investigated in detail.

In Alford investigation was made concerning 2 cases which were brought into the town from outside of the State. Precautions were taken and there was no spread of the disease.

Cases of scarlet fever on dairy farms in Pittsfield, Clarksburg, Lanesborough and Williamstown were investigated. There was no spread of the disease in these instances.

In Greenfield a threatened school outbreak of scarlet fever was checked by prompt action of the local board of health. Daily inspec-

tion of school children was arranged for, with the exclusion of all suspicious cases till the nature of the indisposition became evident.

In the Southeastern Health District the following cases of scarlet fever were reported and compared as follows:—

Total number of cases reported for 1914,	1,402
Total number of cases reported for 1915,	642
Decrease,	760
Of the 642 cases reported, 4 cities made the following return:—	
Fall River,	194
New Bedford,	170
Taunton,	36
Attleboro,	18
	418
Out of 64 towns, 39 towns reported,	224
Total,	642

The number of cases reported for the year shows a decrease of 760 cases as compared with last year. The population considered, by far the greatest number of cases have been reported from 39 out of the 64 towns. The largest number of cases reported for any one of the 4 cities was 194 for Fall River, which is small compared with the population. Better local health regulations, a more strict quarantine, and less dependence upon terminal fumigation appears to be responsible for the decrease this year. Nowhere did it assume the proportions of an epidemic.

In the Wachusett Health District from November, 1914, 17 cases of scarlet fever were reported to the board of health of Athol. Investigation revealed 14 of these to be in two families residing in the country, one living on a dairy farm. Three cases occurred in three different families. The milk from the dairy farm had been voluntarily shut off from sale. There appeared to be no history of contact of the 3 separate cases with the two family groups. In December 6 more cases were reported, with no history of contact with any known case.

In Gardner 3 cases were investigated. They had been removed immediately to the isolation hospital.

Six cases were investigated in Leominster, 3 of which were found to be in the same family, 1 a relative of this family giving a history of contact, and 2 in separate families with history of no known contact. Quarantine was established at the different homes.

During May, 1915, 5 cases were reported in the town of Orange.

Two were found to be in one family while the other 3 were in separate homes. They gave a history of no known contact. Quarantine was established at the different homes. Also, 2 cases were investigated in December, 1 in February, and 8 in March, 1915, in the same town.

In March, 1915, the diagnosis of 2 cases on a milk-producing farm at Sterling was confirmed. Lax conditions prevailed on the place, and it was deemed advisable to stop the sale of milk.

A case occurring on a dairy farm in Fitchburg was investigated in September, 1915, on request of the board of health. They had prevented the sale of milk or milk products from the place. Their action was approved.

Two cases of scarlet fever were investigated at Warwick in December, 1914, and 1 at New Salem, November, 1914. Two suspicious cases of scarlet fever were seen at Baldwinsville on Oct. 13, 1915, in company with the attending physician, and his diagnosis confirmed. Both attended school but in different districts, and there was no history of contact.

Fourteen cases occurring in Leominster between October 4 and October 30 were considered with the board of health. Quarantine was established in each case, and an effort made to prevent further spread. A case was investigated in Leominster on April 24 on a place where milk was produced and sold to the neighbors. Satisfactory arrangements were made so that the sale of milk continued. Home conditions were excellent and afforded the best of isolation.

The North Midland District reports that the attention of the District Health Officer has been called to scarlet fever outbreaks in several places. While the management in some places could be improved, there have been no serious epidemics.

Two cases occurred in a private school with about 40 boys. Before the District Health Officer was called the cases had been isolated, the school closed and nearly all the boys sent home, although exposed, giving a chance for numerous foci of infection. Isolation was strengthened, the school thoroughly cleaned, aired and reopened in a week, no secondary cases of infection resulting.

An epidemic in Andover was investigated. The history was such that it seemed to have started in one school. The investigation showed that it was being carried on by a few who were disregarding quarantine, as there were several cases in homes with no children of school age. Milk and other sources of infection seemed improbable.

A number of cases occurred in Ayer. The board of health asked assistance when a case occurred in the family of a milk dealer in the outskirts of the village. The cases had been confined to six families

and in all contact infection had been traced through either school, Sunday schools or intermingling of families. Isolation seemed lax at the home of the milk dealer, so it was advised to insist on more perfect isolation or stop the milk.

In connection with the Quincy House epidemic, besides those cases reported by the Somerville health officer, others were found in Watertown and Waltham who might readily be added to the list, as they had eaten there at about the time of the others and three or four days before being taken sick. Conference with Dr. Shea showed that every precaution was being taken by the Boston board.

A case was reported on a farm in Chelmsford where they were producing 15 cans of milk for the Lowell market. Those who had charge of the cattle and milk moved to a near-by neighbor, and the milk was allowed to be sold, without any infection.

Investigation in Methuen showed lack of proper control and quarantine in a large town not well organized for public health work. It did not assume epidemic proportions.

SEPTIC SORE THROAT.

During the year, 865 cases of this disease were reported, with 25 deaths.

In the Southeastern Health District there has been an increase of 35 cases of this disease this year as compared with last year. Three cities reported 19 cases, and of 1 city and 64 towns, 1 city and 5 towns reported 18 cases. The following table will serve to make this clear:—

Total number of cases reported for 1915, ...	37
Total number of cases reported for 1914, ...	2
Increase, ...	35
Of the 37 cases reported:—	
Fall River, ...	13
New Bedford, ...	5
Attleboro, ...	1
	— 19
Out of 64 towns and 1 city, 5 towns and 1 city reported, ...	18
Total, ...	37

In the Berkshire Health District there was one isolated case in North Adams, and a small group of cases among the employees of a hotel in Williamstown, all investigated without discovering any definite cause other than that a pantry girl, who served the employees'

table, had had some soreness of the throat. The general milk supply of the hotel was not involved, and no cases occurred among the guests.

The District Health Officer of the Eastern Health District reports an outbreak of epidemic proportions occurred in the Dorchester district of Boston and in Milton. This outbreak was one of septic sore throat and involved the milk route of a Milton distributor who himself produced no milk. His entire milk supply was unpasteurized and was derived from three sources, all of them in Milton. Cases of septic sore throat began to be reported to the Boston board of health April 22; the latter board at once began an investigation. Coincidentally an inquiry was instituted into conditions in Milton, with the result that many cases were discovered in that town as well. About 227 actual cases of septic sore throat were discovered in Boston, 97 per cent of whom took milk of the milk distributor above referred to. Two deaths occurred among these cases. In Milton 84 cases were found, of whom 75 used the above mentioned distributor's milk.

Several confusing factors entering into the situation rendered final judgment as to the party responsible for the trouble very difficult. One of said distributor's sources of supply proved to be from a farm on which was a boy desquamating freely about the hands and giving a history of previous sore throat. Another source of supply showed the presence of cows with garget; the third farm also had cows with pus in their milk. In addition, very shortly after the beginning of the outbreak, members of the Milton distributor's family had sore throats, dating how far back we do not know. But whoever was to blame, the fact remains that this extensive outbreak occurred on that small part of Boston's milk supply which is unpasteurized.

The reports on septic sore throat are inaccurate and misleading. It is usually reported without cultures of any kind, even without differentiating from diphtheria. In the absence of laboratory findings, it is difficult for the average physician to differentiate it from the numerous cases of scarlet fever that have only a sore throat without the rash.

SMALLPOX.

Twenty-three cases of this disease developed in New Bedford in the Southeastern Health District, with ten deaths. This epidemic occurred in what is known as the Cape Verde Colony, the first case discovered being a woman in an advanced eruptive stage of the disease. She claimed to have been vaccinated eight years prior to this event, but there was no evidence of vaccination. It is presumed that she had been vaccinated, but without success. She was found in a boarding

house in one of the thickly settled sections of New Bedford. The next day a similar case was found a short distance from the above location. The parties had visited at a friend's house in the neighborhood in which was found a man recovering from a mild type of the disease.

It was impossible to trace the origin of the disease in this man, but all cases which developed later were directly traceable to this one mild case. The man, it is said, had been successfully vaccinated thirteen years prior to his attack.

The subsequent spread was due to various causes: concealment of cases, ignorance, carelessness and indifference, the last phase of the situation being very noticeable from the fact that these people insisted upon calling at each other's houses during the early stages of the disease and prior to the time of quarantine. It was only after the local authorities had prevailed upon the pastors in charge of these people to impress upon them the necessity of keeping away from houses of friends until the epidemic was under control that the authorities were able to check the spread of the disease.

The vigorous action of the New Bedford health authorities in locating, removing, quarantining, vaccinating and segregating the cases finally arrested the progress of the disease. Notwithstanding this prompt action the fatalities were in excess of 43 per cent.

The epidemic was of unusual violence as evidenced by the percentage of deaths noted. In most cases the type of the disease was confluent, and of the 23 treated at the smallpox hospital 4 were of the hemorrhagic type. The case first treated from which others contracted the disease, as stated, was mild, and the tenth case found was also of a mild form, this patient having been successfully, it is said, vaccinated a few years prior to the attack. Complications in the majority of cases were not infrequent.

A serious phase of the epidemic, one which was not generally known, rests in the fact that pupils in the Donaghy, Thos. Green and Cedar Street schools had been exposed to the disease, and they were closely watched for the usual period, the school inspectors of these schools giving almost their whole time in supervising scholars daily in the rooms affected. Fortunately not a single case developed, and this fact was undoubtedly due to recent vaccinations, as the children under observation had but recently entered the public schools.

This is the first epidemic of a serious type that has occurred in the State for a number of years. As most, if not all, of the cases occurred among foreigners, the question of successful vaccination at ports of entry has been raised. It is well known that a certain number of foreigners, on shipboard and at immigration stations, resort to various

devices to defeat successful "takes." This attitude has also been observed among factory employees.

In recent years the epidemics have been of a comparatively mild type, but this outbreak in New Bedford shows us that the disease has not lost any of its virulence and none of its fatality.

In considering this disease, it must be borne in mind that except for the New Bedford outbreak between May and July, 1915, the rest of the State has been entirely free from this disease.

TETANUS.

Thirty-seven cases were reported in the State during the year; of these, 20 died, giving a death rate of 54 per cent. This disease is of importance principally from its high mortality and the character of its symptoms.

Curative measures so far have been of comparatively little avail in those cases that come on within less than a week of the infection. The greatest field is in prevention. Careful cleansing of wounds, making all suspicious wounds open ones, together with preventive injections of antitetanic serum are always to be in the minds of those treating wounds. When the disease is once established the intravenous and intraspinal injection of the serum is more effective than intramuscular.

These cases were scattered over the entire year. Several occurred in June, July and August. We have been unable to determine that any of them were due to the so-called 4th of July accidents. We are glad to note that the annual sacrifice of lives from needless explosives is fast being excluded. The State does not furnish antitetanic serum, but recommends boards of health to keep it on hand. If its usefulness as a curative agent by modern methods of administration are as encouraging as a few cases would seem to indicate, it might be well for the State to furnish the serum.

TUBERCULOSIS.

In March, 1915, at a meeting of the Public Health Council of the State Department of Health it was voted that an extension of time to Sept. 1, 1915, be granted in which to permit cities to comply, in such a way as would meet the approval of the State Department of Health, with chapter 613 of the Acts of 1911, as amended by chapter 151 of the Acts of 1912, and as further amended by chapter 647 of the Acts of 1914, relative to the establishment and maintenance of a hospital or hospitals for the reception of persons having diseases

dangerous to the public health as defined by the State Department of Health.

On May 28, 1915, the following resolve was signed by the Governor: —

Resolved, That the state department of health be authorized and directed to investigate with reference to the advisability of establishing county or district hospitals for the care and treatment of cases of tuberculosis, from cities and towns having less than fifty thousand inhabitants. Said department shall report the result of its investigation to the next general court on or before the second Wednesday in January, and shall accompany its report with such recommendations for legislation as it may consider to be advisable.

In view of the above resolve the enforcement of the foregoing chapters of the acts of various years is pending, in many instances.

Also at a meeting of the Public Health Council of the State Department of Health in March it was voted that July 1, 1915, be set as the time limit for the establishment and standardization of tuberculosis dispensaries as provided by chapter 576 of the Acts of 1911, as amended by chapter 408 of the Acts of 1914.

The following minimum requirements for tuberculosis dispensaries as defined by the State Department of Health were made March 9, 1915: —

Minimum Requirements for Tuberculosis Dispensaries as defined by the State Department of Health.

1. Control and maintenance: —

The tuberculosis dispensary shall be under the direct control of and financed through the following (in order of preference): —

- (a) The local board of health.
- (b) The local tuberculosis hospital.
- (c) The local general hospital's out-patient department.
- (d) The local antituberculosis association.

2. Supervision: —

The State Department of Health shall have supervision over all tuberculosis dispensaries, through its District Health Officers, as provided by chapter 647 of the Acts of 1914, as follows: "the state inspectors of health (district health officers) shall annually make such examination of . . . dispensaries, both public and private, caring for diseases dangerous to the public health, as in the opinion of the state board (department) of health may be necessary, and report as to the conditions and needs of such . . . dispensaries, to those responsible for the management of the said institutions."

3. Rooms:—

The dispensary shall have at least two outside rooms:—

(a) Anteroom or waiting room. (This may be used in common with other dispensary departments.)

(b) Examining room. (This room must be reasonably quiet.)

The rooms of the dispensary shall be well lighted during the day without the aid of artificial light, shall be heated comfortably in cold weather, and shall be kept in a clean and sanitary condition at all times.

4. Equipment:—

Each dispensary shall be furnished with—

(a) A pair of accurate scales,

(b) A desk or filing cabinet for records,

(c) Record blanks,

(d) Examining stools and couch or table,

(e) Clinical thermometers,

(f) Running water and adequate toilet facilities,

(g) Facilities for receiving and transmitting to a laboratory sputum specimens and a supply of sputum containers for distribution.

(h) Accessories such as:—

Paper napkins, sputum cups, etc.

Leaflets of direction and advice

Diet lists, etc.

All equipment shall be kept in a clean and sanitary condition at all times.

5. Service:—

All tuberculosis dispensaries shall be open for at least one hour on one day, and on one evening per week. Days and hours shall be determined by the local authorities as seems best to fit local needs.

6. Staff:—

Each dispensary shall have appointed at least one physician and one nurse, both of whom shall be in constant, regular attendance. The qualifications and training of the physician so appointed must be approved by the State Department of Health.

7. Location:—

The dispensary shall be reasonably accessible for the citizens who most need the services of a dispensary.

From the standpoint of supervision it seemed to the State Department of Health that dispensary records should be kept in a uniform manner throughout the State, but before recommending such a uniform system, as would seem to meet the required needs, the Director of the Division of Communicable Diseases asked for an expression of opinion from those actively interested in tuberculosis dispensary work, and reasons were solicited based on experience either for or against such a plan of uniform record system. It

was generally thought by those who responded that such a system would be an excellent idea.

Therefore the following minimum requirements for a uniform dispensary record system were made, and this system is in use in most of the dispensaries in the State:—

Minimum Requirements for Uniform Dispensary Record System.

I. Record blanks, folders and rubber stamps:—

- A. Consecutively numbered general card index, arranged alphabetically by names (cards 3 by 5 inches).
- B. Street index arranged alphabetically by streets (cards 3 by 5 inches).
- C. Medical history card.
- D. Rubber stamps (to be used in connection with medical history card):—
 - 1. Incipient.
 - 2. Moderately advanced.
 - 3. Advanced.
 - 4. Suspicious.
 - 5. Not tubercular.
 - 6. Arrested.
 - 7. Lung diagram stamps (2).
- E. Nurse's card.
- F. Correspondence size folders,¹ consecutively numbered and arranged, as per general card index, in which shall be kept medical history card, nurse's card, and any letters or notices or information concerning case.
- G. Form of letter for tracing persons leaving one community for another.

II. Filing equipment:—

- A. Correspondence size unit.¹
- B. Card index tray (3 by 5 inches).

III. Method:—

- A. Records shall be kept up to date.

Recommendation.

It is recommended that each dispensary shall be able to render the following information to the State District Health Officers at any time, in addition to that asked for on the required blanks:—

- I. Cases under active supervision of the dispensary.
- II. Cases not under the supervision of the dispensary.
- III. Cases in State sanatoria or local hospitals.
- IV. Cases not tubercular.
- V. Deaths.

¹ Unless a State District Health Officer deems it wise to approve the so-called invoice size (7½ by 9¾ inches), which may be in use in dispensaries already established.

MEDICAL HISTORY CARD.

Name
Address

Occupation (at present)

Birthplace

Nationality

Referred by

Diagnosis

Date reported to local board of health of

Date

No.

When illness began

S. M. W. Age

Citizen, yes, no
in

Tax

Stage*

FAMILY.	AGE.	BIRTHPLACE.	OCCUPATION OR SCHOOL ATTENDED.	INCOME.	HEALTH.	PAST HISTORY (PREVIOUS DISEASES AND COMPLICATIONS)
						Present illness began Previous treatment Height Weight: Normal Present Loss of in complaints Chest development Chest expansion Appetite Bowels Fever Night sweats Cough Sputum Chills Haemoptysis (date and amount) Throat Alcohol, none, mod., exc. Tobacco, none, mod., exc. Supposed cause of disease Physician's signature

Family History

Exposure

Has the patient ever been to a state sanatorium?

or TB hospital?

If so, when and where

* Incipient, moderately advanced, advanced

(Over)

DATE OF EXAM. BY PHYSICIAN	DIAGRAM AND CLINICAL NOTES	PHYSICIAN'S NAME

NURSE'S CARD.

Name
Address

History No.

DATE OF:	(NOTES OF FIRST VISIT)
FIRST VISIT	Home Sanitation: Personal hygiene: Occupation sanitation: How does patient now spend his or her time? Landlord's name and address: Employer's name and address:
SUBSEQUENT VISITS	SHOW CLEARLY THE CONDITIONS UNDER WHICH THE PERSON LIVES AND WORKS, AND CARE TAKEN OF SPUTUM

[Form of letter for tracing persons leaving one community for another.]

Board of Health.

GENTLEMEN:— This is to notify you that
suffering from tuberculosis and treated at this dispensary from
to has declared $\left\{ \begin{array}{l} \text{his} \\ \text{her} \end{array} \right\}$ in-
tention of going to your town.

Very truly yours,

It was thought from the beginning that it would be of very practical advantage to the tuberculosis dispensary work if the nurses engaged could be regularly brought together at some common meeting place and have certain aspects of their work emphasized to them and be given opportunity for a free exchange of ideas with the other

nurses from the various parts of the State, so that they might improve their personal grasp on their local tuberculosis situation. In short, it has been felt that inasmuch as it was impossible to fill these positions with nurses completely qualified as to training in tuberculosis dispensary work, we must seek to do the next best thing and help train them toward a uniformity of methods, results and purpose after they were already in the work.

A co-operative arrangement has been entered into by the Instructive District Nursing Association of the city of Boston and the State Department of Health by which monthly conferences are held. Further, if the tuberculosis dispensary work is worth doing at all it is worth doing in as efficient a manner as possible, and by means of these conferences the nurses will in effect receive a postgraduate course of instruction in the details of their work, and will have an opportunity to meet and exchange ideas with other nurses doing similar work throughout the Commonwealth.

Relative Standing of Tuberculosis Dispensaries in Cities and Towns per 1,000 of Population based on 1915 State Census, July 1, 1915, to Dec. 31, 1915.

CITY OR TOWN.	Average.	Based on Number of Examinations.	Based on Number under Supervision.
1. Gardner, ...	5.6	5.2	6.1
2. SALEM, ...	5.2	2.1	8.3
3. BEVERLY, ...	5.0	4.0	6.0
4. BOSTON, ...	4.2	1.6	6.8
5. LEOMINSTER, ...	2.8	2.3	3.3
6. Wakefield, ...	2.4	1.6	3.3
7. Arlington, ...	2.3	2.6	2.1
8. Webster, ...	2.1	2.4	1.9
9. FITCHBURG, ...	2.0	2.4	1.6
10. LYNN, ...	1.9	1.5	2.3
11. Milford, ...	1.9	3.0	0.8
12. QUINCY, ...	1.9	2.4	1.3
13. NEWBURYPORT, ...	1.8	1.3	2.4
14. CAMBRIDGE, ...	1.8	1.6	2.1
15. BROCKTON, ...	1.8	1.3	2.4
16. NEW BEDFORD, ...	1.7	2.2	1.2
17. MALDEN, ...	1.7	2.6	0.8
18. CHELSEA, ...	1.5	0.5	2.6
19. Brookline, ...	1.4	1.9	1.0

Relative Standing of Tuberculosis Dispensaries, etc. — Concluded.

CITY OR TOWN.	Average.	Based on Number of Examinations.	Based on Number under Supervision.
20. Peabody, ...	1.4	2.4	0.4
21. REVERE, ...	1.4	0.9	1.8
22. EVERETT, ...	1.3	1.1	1.5
23. GLOUCESTER, ...	1.3	2.1	0.5
24. WOBURN, ...	1.2	1.5	0.9
25. NORTH ADAMS, ...	1.1	1.5	0.7
26. ATTLEBORO, ...	1.1	1.2	1.1
27. LAWRENCE, ...	1.0	0.6	1.4
28. TAUNTON, ...	1.0	1.3	0.7
29. MELROSE, ...	0.9	0.7	1.1
30. HAVERHILL, ...	0.8	0.9	0.8
31. NORTHAMPTON, ...	0.8	0.09	1.5
32. WORCESTER, ...	0.8	0.8	0.7
33. Westfield, ...	0.7	0.8	0.6
34. HOLYOKE, ...	0.7	0.9	0.6
35. FALL RIVER, ...	0.7	1.0	0.5
36. SPRINGFIELD, ...	0.6	0.3	0.1
37. Plymouth, ...	0.6	0.6	0.6
38. CHICOPEE, ...	0.6	0.6	0.6
39. WALTHAM, ...	0.5	0.3	0.8
40. MARLBOROUGH, ...	0.5	0.7	0.4
41. LOWELL, ...	0.5	0.5	0.5
42. NEWTON, ...	0.4	0.02	0.9
43. Southbridge, ...	0.4	0.5	0.4
44. Adams, ...	0.3	0.2	0.4
45. MEDFORD, ...	0.3	0.4	0.1
46. Clinton, ...	0.3	0.6	0.0
47. PITTSFIELD, ...	0.3	0.4	0.2
48. Weymouth, ...	0.2	0.2	0.2
49. Watertown, ...	0.2	0.1	0.2
50. SOMERVILLE, ...	0.1	0.1	0.1
51. Greenfield, ...	0.1	0.3	0.0
52. Framingham, ...	0.1	0.1	0.1
53. Winthrop, ...	0.0	0.0	0.0

DETAILED INVESTIGATION REPORTS.

There were 243 reports showing detailed investigation (not including those who died and cases in hospitals). All these cases were at home or with friends or relatives.

Nationalities.

American, ...	87	Polish, ...	6
Not stated, ...	33	Scotch, ...	6
Irish, ...	24	African, ...	5
Swedish, ...	12	German, ...	3
French, ...	11	Jewish, ...	2
Canadian, ...	9	Armenian, ...	1
English, ...	8	Austrian, ...	1
Italian, ...	8	Dane, ...	1
Portuguese, ...	8	Dutch, ...	1
Russian, ...	8	Finnish, ...	1
Lithuanian, ...	7	Syrian, ...	1

Residence in United States.

Always, ...	74	19 years, ...	2
45 years, ...	1	18 years, ...	1
40 years, ...	3	16 years, ...	1
37 years, ...	2	15 years, ...	2
36 years, ...	2	14 years, ...	1
34 years, ...	1	13 years, ...	1
33 years, ...	1	12 years, ...	1
32 years, ...	3	11 years, ...	1
30 years, ...	1	10 years, ...	3
27 years, ...	1	9 years, ...	4
25 years, ...	3	8 years, ...	4
24 years, ...	2	7 years, ...	2
23 years, ...	1	6 years, ...	1
22 years, ...	1	5 years, ...	1
21 years, ...	3	Less than 5 years, ...	14
20 years, ...	7	Not stated, ...	98

Home Sanitation.

Excellent, ...	16	Poor, ...	¹ 29
Good, ...	90	Not stated, ...	68
Fair, ...	40		

Personal Hygiene.

Excellent, ...	8	Poor, ...	26
Good, ...	69	No sputum, ...	27
Fair, ...	8	Not stated, ...	105

¹ Poor personal hygiene, 14.

Condition of Other Members of Household.

Good in, ...	133
Tuberculosis in, ...	19
Delicate people or people with suspicion of tuberculosis, ...	25
Diseases other than tuberculosis, ...	3
Not stated, ...	63

Anything to suggest Cause of Disease or Source of Infection.

Contact infection, ...	39
Previous personal history, ...	31
Overwork, ...	22
Unsanitary home conditions, ...	9
Alcoholism, ...	7
Dusty occupation, ...	6
Carelessness, ...	1
Decayed tooth (adenitis), ...	1
Over physical training, ...	1
Not stated or not known, ...	126

Occupation of Patients (at Present).

Housewives or housework, ...	36
School, ...	23
Shoeworkers, ...	6
Clerks, bookkeepers, stenographer, ...	5
Mill, ...	5
Teamsters, ...	5
Light work out-of-doors, ...	3
Box shop, ...	2
Jewelry shop, ...	2
Waitress and chef, ...	2
Agent for Edison Light Company, ...	1
Butcher shop, ...	1
Carpenter, ...	1
Engineer, ...	1
Farming, ...	1
Fishing, ...	1
Fishing and orchestra, ...	1
Laborer, ...	1
Machine shop, ...	1
Manicure, ...	1
Marble cutter, ...	1
Painter, ...	1
Purse maker, ...	1
Telephone operator, ...	1
Not stated, ...	140

Supervision of Patients.

Physician, ...	116
Dispensary, ...	34
District or board of health nurse, ...	21
Physician and district or board of health nurse, ...	20
Out-patient departments of hospitals, ...	¹ 10
Local antituberculosis society, ...	2
Associated Charities, ...	1
Out-patient department and board of health nurse, ...	1
No supervision, ...	38

Of these patients 57 had been in hospitals, 143 never had been in hospitals, and 43 were not stated.

Form of Disease.

Pulmonary, ...	167
Other forms, ...	24
Not stated, ...	52

Tuberculosis Dispensaries.

To secure the enforcement of the law relative to the establishment of tuberculosis dispensaries, it was found necessary to make a considerable number of visits to the communities affected by this statute.

Of the 54 communities within the State, having a population of 10,000 or over, but 13 had made suitable provision for dispensaries; in the other 41 communities there were not only no dispensaries but there appeared in the greater number of instances to be no public or official sentiment favoring such innovations. To be sure there was no apparent inclination among these communities to avoid compliance with the law but rather an attitude of indifference, with perhaps a feeling among them that a tuberculosis dispensary in the city or town was an institution without which they could get along very well.

It was necessary at first to overcome this prejudice or antagonism, to point out to the authorities and others the actual incidence of tuberculosis in each community, and to show the excellent results that had followed the maintenance of dispensaries by other communities and private organizations.

It is by no means certain, however, in fact it is to be doubted, that these measures of persuasion would have met with other than failure, had it not been that the law was mandatory and that compliance with it was a necessity.

¹ Massachusetts General Hospital, 8.

Whatever the motives responsible for the decisions reached by the authorities, tuberculosis dispensaries have been established and are now being maintained in each of these communities. We have good reason to believe that in few dispensaries is there a mere perfunctory compliance with the law, but that in nearly every instance an actual interest in the work is being taken. The establishment of the dispensary has brought with it an increased responsibility, and, we think, a desire to make the best of the work. As they grow and broaden, these dispensaries will be responsible not only for a diminution in the death rate from tuberculosis but for a general betterment of the conditions of health within the community which they serve.

Of the 13 dispensaries which were already in existence when the enforcement of the law was undertaken by the State Department of Health, 6 were maintained by private organizations, while 7 were maintained by municipalities. In many of these communities full-time dispensary nurses were maintained, and an endeavor was made to secure the services of a full-time nurse in as many as possible of the several other cities and towns in which a tuberculosis dispensary would be necessary. This endeavor met with a considerable degree of success, for as at present organized most of these communities have nurses who give all their time to dispensary work. In the smaller communities arrangements were made by the local health authorities by which the necessary amount of nursing services could be given to the work.

Endeavor was also made to make the work and purposes of the dispensary more attractive to the general public through the use of a designation which would not include the use of the word tuberculosis. As a result several of these dispensaries are known and designated as "public health dispensaries," a name which, as the work broadens, will more accurately describe their purposes.

It is worth while to record here the way in which each community responded when it had finally decided to establish a dispensary.

Everett. — In this city a private dwelling owned by the city, advantageously located and well adapted for dispensary purposes, was taken over and equipped for board of health and dispensary work, with a full-time public health nurse.

Beverly. — The dispensary was first organized by a group of individuals and when well established was taken over by the city and placed in charge of a special committee on which the local board of health was represented. This dispensary is centrally located, finely equipped and well organized, with a full-time public health nurse.

Winthrop. — To meet the requirements of the dispensary law the town of Winthrop erected a small building centrally located. This building was thoroughly equipped, and is admirably adapted for the purposes of a dispensary and the local board of health.

Wakefield. — This is one of the smaller communities affected by the dispensary law. Two adequately equipped and well-located rooms comprise the dispensary. A part-time nurse has given faithful service and set a standard for further work.

Gloucester. — Has excellently equipped rooms in an ideal location, and through the services of a full-time nurse has gone into the work with an energy which should make for a large degree of success.

Haverhill. — Has adequate and well-equipped accommodations in the municipal building. A full-time nurse gives her time to the work.

Melrose. — The dispensary in Melrose is maintained at the Melrose Hospital through an arrangement which allows the local board of health to have full authority over the work and over the services of the dispensary nurse, although the funds for the work are given by the hospital authorities.

Peabody. — Peabody had a building erected for the purposes of a dispensary and well equipped for this purpose. It lacked however an adequate organization, a deficiency which has since been supplied. This dispensary is now doing good work and has the services of a full-time nurse.

Revere. — Revere has complied with the letter of the law by equipping the necessary number of rooms with no more than the necessary furnishings. This city was fortunate in securing the services of a full-time nurse, whose painstaking work has almost made up for the lack of support of the city authorities.

Lawrence. — Has a tuberculosis dispensary run by the antituberculosis league, which has been in operation for some years. They have a staff of physicians. The secretary does some visiting follow-up work, and they have the services of a district nurse from the Lawrence Tuberculosis Hospital. The superintendent of the hospital has charge of the nurse. The physicians are in charge of a supervising physician.

Methuen. — Owing to its geographical situation Methuen has been allowed to contract with Lawrence in caring for its dispensary cases.

Medford. — Has a tuberculosis dispensary under the antituberculosis league which had been running one for some years, but disbanded for lack of patients. It has been reopened, the board of health standing the necessary expense for nurse and appliances. Nursing is done by the district nurses.

Waltham. — Has its dispensary in the office of the city physician, and has a full-time nurse.

Somerville. — Is running its dispensary in connection with the tuberculosis hospital, — unsatisfactory.

Watertown. — Has a general dispensary in the board of health rooms, a staff of physicians, and uses the district nurses.

Woburn. — Has rooms in connection with the board of health. The work is in charge of the city physician, who is a woman, and necessary nursing is received from the Choate Hospital.

Arlington. — Has rooms in Town Hall, and uses the district nurse.

Chicopee. — A very completely equipped set of rooms was secured for a

general dispensary. This had been carried on for a number of years by the Dwight Company as a private enterprise. Their physician was appointed to have charge of the tuberculosis end. A nurse has at last been appointed to combine the tuberculosis dispensary work with board of health work, and is to take charge November 22.

Holyoke. — Secured rooms connecting with the board of health in the City Hall annex. A nurse was appointed under the title of "dispensary worker." Her work has been excellent.

Northampton. — The dispensary is in the office of the physician appointed for the dispensary work, as no centrally located rooms were obtainable. District nurse is used for dispensary nurse, — not fully satisfactory.

Westfield. — Board of health has moved to new quarters where they could have dispensary accommodations included. The district nurse was appointed dispensary nurse, with satisfactory results.

Worcester. — Had already a dispensary connected with its tuberculosis hospital, — satisfactory.

Southbridge. — Satisfactory quarters were equipped in the Town Hall, and the work is progressing.

Webster. — Quarters were furnished in one of the business blocks, and remarkably good work is being done.

Milford. — The dispensary is in the office of a local physician, and had been there previous to the enforcement of the law. With the enforcement of the law he has been able to increase its efficiency.

Marlborough. — The local board of health rooms in the City Hall have been equipped, and to date Marlborough has made a fairly satisfactory showing.

Newton. — The dispensary is known as Newton Tuberculosis Dispensary and is located at the Newton Hospital and employs a nurse.

Framingham. — The dispensary is known as the Framingham Tuberculosis Dispensary. The nurse from the Framingham Hospital is on duty.

Lowell. — This has a tuberculosis dispensary, in connection with the board of health, with a special physician and full-time nurse located in City Hall.

Malden. — This community through its board of health has gone into the work with enthusiasm and intelligence. It possesses a centrally located and very well equipped dispensary with a nurse who gives her full time to the work. The authorities of other dispensaries might well study the organization, purposes and work of this institution.

Fitchburg. — The dispensary is well organized and doing good work.

Gardner. — The dispensary is well organized and doing good work.

Leominster. — The dispensary is well organized and doing good work.

Clinton. — The tuberculosis hospital dispensary is unsatisfactory, on account of the distance from the center of population. The subject is under consideration, and it is hoped that some satisfactory solution will be obtained.

Boston. — The dispensary of the city of Boston is the out-patient department of the Consumptives' Hospital; it has a large corps of physicians and nurses, and is satisfactory.

Brookline. — The dispensary is maintained by the board of health in the Town Hall, and utilizes the services of a full-time nurse.

Cambridge. — The only tuberculosis dispensary of the city is maintained by an antituberculosis society. It employs one of the local district nurses for half her time. The question of the board of health taking over the dispensary is now under consideration.

Brockton. — This dispensary is under the auspices of the local board of health. The outside nursing work is being done by the district nursing staff. The clerk of the board of health assists the physicians in the clinic.

Quincy. — A dispensary was established in July. First location was excellent, but they were obliged to vacate on account of complaints. The clinic is now being held in the office of the dispensary physician pending the acquirement of better accommodations. The services of an excellent full-time nurse are employed.

Weymouth. — A site was early acquired for a dispensary, but the town was slow in getting it started. The clinic is now in operation. At present the local district nurse is employed on part time to do the supervision work, but changes are contemplated which will result in the acquisition of a trained social worker.

Springfield. — Already had a dispensary in actual existence, under control of the antituberculosis society. This is believed to be satisfactory.

Attleboro. — The dispensary consists of three rooms in the Bronson Building in the center of the city. There is a health officer in charge and a trained nurse.

Fall River. — The dispensary is under the direct control of and financed through the trustees of municipal hospitals. The local board of health pays the trustees of municipal hospitals a fixed amount for the care of such tuberculosis cases as the local board of health may see fit to refer to the tuberculosis dispensary. Nurses are on duty from Bay View Hospital. This dispensary is located in the Globe Building.

New Bedford. — The dispensary is under the direct control and financed through the local antituberculosis association. The board of health nurse is present at the dispensary on Saturday and a nurse from the Sassaquin Tuberculosis Hospital is on duty Wednesday. It is also partly under the control of the local (Sassaquin) tuberculosis hospital, non-municipal.

Plymouth. — The dispensary is under control of the local board of health and the school nurse is utilized.

Taunton. — The dispensary is under control of the local board of health and has a nurse who is known as "health instructor."

Adams. — The dispensary is located in the office of a physician, and the Metropolitan nurse is utilized in connection with the insurance work.

North Adams. — The dispensary is known as the board of health dispensary and is located west of City Hall. The nurse is known as board of health nurse.

Greenfield. — The dispensary is known as the tuberculosis clinic and is located in a physician's office. The district nurse is in attendance.

Pittsfield. — The dispensary is known as House of Mercy Dispensary, and the board of health nurse is utilized.

It is pertinent to state at this time what we believe must be done before we are able to show in our campaign against tuberculosis results commensurate with the great sum annually spent in this Commonwealth in the attempt to control the disease. At the present time the amount charged against the control of tuberculosis in this State is well over \$1,000,000. This amount takes no account of the expenditures at Tewksbury, Titicut and State institutions other than the State sanatoria, the expenditures of private organizations and charities and the expenditures of the smaller towns. It is highly probable that the total amount expended in the direct control of the disease will exceed \$1,500,000. The direct financial loss to the State through invalidity, dependency, and death can only be conjectured.

May we for the purposes of this report mention the agencies which are concerned in the control of this disease, a disease which annually causes the death in this State of between 4,000 and 5,000 persons. These agencies are: —

- (a) The State Department of Health and the State District Health Officers.
- (b) The Trustees of Hospitals for Consumptives and the sanatoria under their control. •
- (c) Local boards of health.
- (d) Local tuberculosis dispensaries.
- (e) District and local hospitals for tuberculosis.
- (f) Local tuberculosis associations.

We have put these agencies down as they occurred to us without reference to their relative importance or to their relation one to another. If these agencies are working in harmony; if there is no overlapping of authority; if there is no wasted effort; if all expenditures are economically directed; if these agencies so work together as to reduce most effectively the death rate from tuberculosis, the period of invalidity from the disease, and the danger of the conveyance of infection from those already ill with the disease, — then there is no reason whatsoever why the present functions of any of these agencies should be disturbed. If, on the other hand, the conditions above enumerated are not being met, then there is need for more efficient plan of procedure.

To those who have given the subject careful thought, it must appear that there is overlapping of authority, that there is wasted effort, and that expenditures are not so directed as to return the greatest possible results of a successful campaign against tuberculosis.

The law gives the State Department of Health the right to inquire into the conditions affecting the health of the people of the State,

and it gives to the State District Health Officers the right "to take such steps as after consultation with the State Department of Health and the local health authorities may be deemed necessary." The State Department of Health is required to approve of plans for the construction of hospitals for tuberculosis, and to define the minimum requirements for tuberculosis dispensaries; the State District Health Officers may inspect hospitals where consumptives are cared for, and may inspect the tuberculosis dispensaries in order that a proper standard of administration may be upheld. These duties are important, but neither they nor any other power of the State Department of Health permits of any approach to an adequate control of the disease through a central agency.

The Trustees of Hospitals for Consumptives exercise control over the State sanatoria and regulate the admission of patients to these institutions. Under the present law any physician in the State may make application for the admission of a patient to one of the State sanatoria. As a result, these institutions are largely filled, not with patients for whom there is some hope of recovery, or a prolonged period of usefulness, but with patients bedridden or in the advanced stage of the disease.

It is perfectly true that we must not expect to measure the efficiency of a sanatorium by those persons who are discharged therefrom, and who are again able to take up at least a part of the work of the community. On the other hand is it not true that if we do not reserve the sanatoria for hopeful cases exclusively, we are denying proper treatment to those who, failing to receive it, will become in a short time advanced cases, and who will in turn become units in the vicious circle of infection?

The abuse or misuse of the State sanatoria has as its corollary the misuse of local hospitals, where, instead of advanced cases, we are apt to find those of the ambulatory type, and thus neither they nor the State sanatoria meet fully or even to a fair degree the purposes to which these institutions should logically be put. Neither is there any assurance that any material change will appear in these conditions unless there is also a material change in the manner in which patients are admitted to these institutions. It seems to us that before we shall undertake to make any change in these conditions, we should recognize certain classes among the consumptives in the State. Roughly, these classes or divisions might well be —

1. Those in any stage who may be properly cared for in their homes in such a manner that they may receive proper care for themselves and may not exist as a source of infection to others.

2. Those who in their homes may be properly supervised by the authorities in charge of the dispensaries.

3. Those advanced cases who may not be properly cared for at home but who should be cared for at local or district or county hospitals.

4. Those cases in their incipiency, or in that stage of the disease where improvement may be looked for, and who would be benefited by treatment in a sanatorium.

The recognition of any such classification as this is of little value unless there is some authority who may, after proper investigation, state to which class any given consumptive belongs, and who has the power to admit to local hospitals and sanatoria only those persons who properly belong in these institutions.

Any such plan is quite practicable and may be carried out with but little additional expenditure. The plan we have particularly in mind is this: —

1. That each State District Health Officer should have on a card catalogue, classified in some such manner as above, the names of each person within his district reported as ill with tuberculosis.

2. That before a patient might be admitted to a State sanatorium, it would be necessary for him to receive from the State Department of Health a certificate, stating that he was a proper person to receive sanatorium treatment.

3. This certificate might then be given to the Trustees of Hospitals for Consumptives, who would admit this person to the sanatorium best suited for his reception.

In this manner there would be admitted to the sanatoria only those patients who would be benefited materially by treatment therein.

The question naturally comes, how with their many other duties could the District Health Officers be expected to acquire the information concerning each patient which would be necessary to carry out such a plan successfully. This information could be secured through the employment in each district of a public health nurse who would act, in a way, as a sort of an assistant to the District Health Officer, or at least it would work out that way. The nurse would be materially aided by the information which she could secure from the dispensaries in the larger communities. Where there appeared to be any question as to the classification of any individual patient, the District Health Officer himself would, of course, make such inquiry or investigation as would be necessary, including a physical examination.

We are of the belief that such a nurse would be able not only to

assist in the classification of those ill with tuberculosis but that she would be able to visit the cases of ophthalmia reported in the district, or at least those not convenient for the District Health Officer to see conveniently and economically. It is probable, also, that the nurse would at least have some time to give to infant welfare work and to the educational features coincident to this work within the districts.

The sum necessary for the maintenance of these nurses (eight in number) would not be great, and we are of the firm belief that it would be an economical expenditure which would manifest itself not only in future but in immediate results. If through the use of these nurses we accomplished the filling of our sanatoria only with incipient or favorable cases, their employment would be amply justified.

This classification of cases, and the control of the admission of cases to State sanatoria, would place a powerful factor in the control of tuberculosis where it belongs, — in the hands of the State health authority. It is a very easy thing for a community, figuratively, to shrug its shoulders and say: "Oh, yes, so and so has tuberculosis. Well, we'll send him to the State sanatorium. It won't cost us much. The State pays most of the bills." It will be quite another thing when a community realizes that it cannot send such cases to the sanatoria but that it must find at home some accommodation for these persons. Some of our communities, we believe, have never quite realized just what constitutes their tuberculosis problem. With an object lesson or two at hand, they may sometime be made to realize that perhaps after all it would be well to spend money to prevent the disease rather than to keep on caring for those ill with it.

Tuberculosis in the Smaller Communities.

The tuberculosis cases in the smaller towns and in the towns of the Cape region of the Commonwealth in particular, present certain peculiar features that deserve special mention.

(a) *Smaller Towns in General.* — Cases of tuberculosis developing in the small towns, if hospitalized at all, are usually sent to the State sanatoria. They invariably suffer from nostalgia, and forsake the sanatoria for home, friends and the old haunts. Here they are indifferently cared for, as a rule, by the local authorities, with occasional aid from friends or relatives.

This applies to natives only. Foreigners are not so well treated. They are, if tubercular, not very desirable persons to have about, and are not wanted if unable to work. If not anchored by family ties, they are apt to take the hint and move to another town. Finally,

they return to that part of the old country from which they originally came, — there to die.

Special studies in small towns will reveal quite a number of tuberculosis cases. This only adds to the town problems as the authorities claim they have no money for the care of such cases. The fixation of settlement usually results in the advice to move on, or stay and fight it out, at home or sanatorium. Foreigners will not stay at the sanatoria. They usually come home and expose the rest of the family to house infection.

(b) *Cape Towns.* — In some of these towns a certain part of the population is a mixture of white, Indian and Portuguese, and among such people the susceptibility to tuberculosis is marked.

For various reasons the disease does not pursue an active type. They have a cough, dyspnoea, with scant expectoration. They are thin, but wiry, with a propensity to procreate, and are usually successful in adding to the population, contrary to the usually accepted idea of what they should do. Physical examination discloses but little moisture, few rales, mostly dry, with leathery creaks, and evident fibrosis of lung.

They are a long time dying, and may even live long enough to be numbered among the oldest inhabitants, as evidenced by cases in the towns lying between Buzzards Bay, Barnstable, Hyannis and Falmouth.

A study of the office records of mortality of tuberculosis in the State of Massachusetts shows that deaths from consumption have been reduced in Massachusetts in thirty years from 300 per 100,000 population to 100 or two-thirds of the total number.

The population has more than doubled in the meantime, so there is still quite a problem; but in the face of the additional number of people to draw from, the actual number of deaths have steadily decreased. Whether the death returns are given any more honestly or not we have no figures to show, but it is safe to say they are no worse.

TYPHOID FEVER.

In one of the districts 144 cases were reported from 17 towns and cities. All were scattered cases with no demonstrable point of infection except in two small outbreaks, which were investigated and found due to contact with a primary case.

Rochdale. — During the month of October, 1915, 18 cases of typhoid were reported from the village of Rochdale, — a community of about 2,000 inhabitants, largely foreign, only 10 per cent. of which are

American or Irish-Americans. About 60 per cent. are French-Canadian, while the remainder are Polanders, Dutch, Italian and various mixed European races.

At the A dairy, 175 quarts of milk are produced daily under satisfactory conditions. The only history of illness on the premises was that of one, who milked and peddled the same. He was up and about, doing his work, but because of a history of malaria, a Widal was taken, which was returned positive, and the local board of health was instructed forthwith as to the necessary precautions. The entire supply goes to Rochdale. Occasionally a can is sold to the other local dealers when their supply is inadequate. This has been done within the last two or three weeks, although no record of the same was made.

At the B dairy, 160 quarts were produced under satisfactory conditions. This entire supply goes to Rochdale. No history of illness on the premises was obtained, and aside from borrowing a can or two from the other local dealers, no milk is purchased.

At the C dairy, 125 quarts were produced and handled under satisfactory conditions. No history of illness was obtained here and the entire supply went to Rochdale. The owner stated that aside from borrowing a can of milk from the other local men, no milk was purchased.

At the D dairy, 35 quarts were produced and handled daily under satisfactory conditions. The entire supply went to Rochdale, and no history of illness was obtained on the premises. Thirty quarts were purchased daily from another farm.

At the E dairy, 30 quarts were produced and handled daily under satisfactory conditions. The entire supply went to Rochdale.

From the milk history we find that every case was supplied directly or indirectly by milk from dairy A.

The water supply of this village is from a system of five tubular wells, driven about 250 feet from the Blackstone River and 225 feet from the house of the first case. The water is pumped up to a side hill reservoir, about one-half mile to the west of the village. This reservoir also receives a comparatively small amount of ground water in a filter gallery. The water in this filter gallery was slightly turbid, but not polluted.

These wells, according to the 1905 report of the State Board of Health (page 67), showed evidence of pollution from some near-by source, and it referred to the possibility of drawing ground water which would not be good, as well as the possibility of the Blackstone River water filtering through into this supply, and further stated that a well on the other side of the gravel ridge would probably give better

results. The supply was approved with the understanding that frequent analyses be made. This was done at Worcester regularly until the death of Mr. —, since which time the analyses have been irregular. On the first visit to Rochdale, Mr. — of the — Company, whose mill is in the village, showed a report of the analysis of a sample of water taken three days before. It was examined at the Worcester Polytechnic Institute, and the report stated that the water showed evidences of sewage pollution and was not a safe supply for drinking purposes. Samples were taken by our engineers and their results showed evidence of sewage pollution.

For fire purposes the Blackstone River water is pumped through all the village mains. A check valve is provided, which shuts off the well supply before the river water is turned into the main. After the fire, the mains are flushed and the check valve opened. On September 27 a fire occurred in the village near School Street, *i.e.*, in the district where most of the typhoid cases occurred. On this day, from 11 to 12 A.M., Blackstone River water was pumped through the mains, and, in this way, delivered direct to every home faucet as long as the pumps were in operation. The people in the village were supposed to be aware of this fact and not to drink water during a fire. The situation was gone over carefully with the engineers of our department who co-operated in this matter and who are now considering plans for improving these conditions.

Grafton. — During the month of May, 1915, 22 cases of typhoid were reported from the Grafton Insane Hospital. This hospital consists of the Grafton colonies and the Worcester colonies, which were formerly known as the Worcester Insane Hospital. Twenty of these cases were in the Grafton colonies, the remaining 2 in Worcester. In Worcester one positive Widal was obtained May 8 and one May 15. Both of these cases were on the female side in different wards, and no cases, or suspicious cases, were found among male patients or any nurses, attendants or employees. These 2 cases, while from different wards, were served from a common kitchen, where the food, dishes, etc., were handled by patients and employees.

The first 3 cases in North Grafton were from three different wards, fed in three different dining rooms, served from a common kitchen, where the food is handled as at Worcester. These three dining rooms and kitchen are in the Pine Service Building. In this building 330 patients and 40 nurses take their meals. Very little of the nurses' food was handled by the patients as most of this was done by the cook and her assistants, while practically all of the patients' food was handled and served by the patients. In all departments at Grafton milk was freely served and used three times a day by the employees.

The milk from the hospital was obtained from two sources, — one in Grafton, the other in North Grafton, — as well as about 200 quarts produced at the colony at North Grafton. All the milk, however, was not mixed. None of the B milk was used in Grafton. None of the milk from the farm at colony was used in Worcester.

The milk from the A farm in Grafton was used at both Grafton and Worcester, while the B milk was used only at Worcester. As far as the milk supply was concerned, the only common source for both departments of the institution was that of the A farm. The milk was not bottled, but delivered from A in his own cans, which were handled, collected and washed by his men. The milk from B was collected in cans furnished by the institution. These cans, as well as those used for milk at the two farms in Grafton, were furnished by the institution, and washed with steam and hot water at Grafton, but were not actually sterilized. At the onset of the outbreak, satisfactory extra precautions were taken forthwith.

No history of recent illness, *malaise* or indisposition of any kind was obtained from any one handling milk or food. At the first visit to the institution, it was suggested that Widals be taken from everyone coming in direct or indirect contact with milk or other food at both Grafton and Worcester. No positive Widals were obtained in Worcester. Three positive Widals were obtained at Grafton as follows: —

1. W. H., a milker at the A farm (the one milk supply common for both Grafton and Worcester). This man was examined and cross-examined for a history of typhoid or anything suggesting it. He declared, however, that he had never been sick a day in his life with the exception of a slight cold about a month prior to this date. He had been employed here a little over a month previous to which time he had been employed by the Draper Manufacturing Company at Hopedale for seven years.

2. M. W., a patient who had been at the institution for several years but with nothing suggestive of typhoid in her past record or history. This patient handled the food in the kitchen at the Pine Service Building, North Grafton, where the first 3 typhoid cases had their meals.

3. B. M., who, with M. W., handles food in the same kitchen. The hospital records showed that B. M. had typhoid here ten years ago, September 1905.

These 3 cases were removed from the food department and kept under observation. Several specimens of urine and feces were examined from these cases, but with negative results, with the exception of B. M. Here positive results were obtained independently by the

bacteriologist of the Worcester board of health and the bacteriologist of the State Laboratory.

The kitchens, dining rooms, barns, dairies, etc., were thoroughly inspected, and found to be in satisfactory condition.

The water supply at Grafton was from driven wells and at Worcester, the city supply. The sewage was taken care of by the city sewer, while that at Grafton was disposed of by means of a series of well laid out filter beds.

At the onset of the outbreak it was suggested that everyone in both institutions be immunized, and arrangements were made with the laboratory to supply the anti-typhoid serum, so that 100 people daily were inoculated until everyone, — physicians, nurses, attendants, patients and all employees, — in both institutions were made immune.

Newton. — During the third week of August, 5 cases were reported. With the exception of 1 case who came to the city with the disease, they were supplied with milk by A, West Newton, near the Waltham line. There were also two other suspicious cases on this milk route, which supply was discontinued by the local board. This milk supply (13 cows) is peddled in Weston, Newton and Waltham near the Newton line. There were three positive cases in Waltham using this milk. When the premises were visited, conditions were found satisfactory, and no history of illness on the premises could be obtained. It was learned, however, that a man by the name of J, who used no last name, was employed there from July 14 to July 17, and left suddenly and could not be located. A man named H, also using no last name, replaced J July 18, but ran away for parts unknown on August 16, as soon as Dr. Curtis took his Widal. The Widal was negative, but a history of a severe illness of four weeks' duration three years ago strongly suggested typhoid.

Some milk was purchased by the A dairy, and the tributary supplies were investigated with negative findings. No further cases developed.

The Eastern Health District may be mentioned as having had typhoid in Easton, Foxborough, Braintree, Bridgewater and Abington.

In the Berkshire Health District 106 cases of typhoid fever were reported.

North Adams and Pittsfield are the natural hospital centers for a considerable territory. In consequence, typhoid patients are brought to these places from without the State for hospital care, cases for which these communities are in no way responsible. There were two such cases in Pittsfield and four such cases in North Adams.

Of 25 cases reported in Pittsfield, 8 (over 30 per cent.) were brought into the city for hospital care; while in North Adams, of 30 cases reported no less than 11 (over 36 per cent.) were brought to the hospital from other towns and from outside the State. In both cities a number of these cases are fatal, and herein undoubtedly lies a very considerable factor in the habitually high typhoid mortality rate for the county as well as these two cities.

There were no special outbreaks, save that of 17 cases in Adams, 15 cases were reported during June (1), July (9) and August (5). These cases were investigated in detail in conjunction with the local health authorities. No common factors were definitely established, and while contact may account for a second case in one family, and while another case was ill on its arrival from Canada, contact does not offer an adequate explanation, since the patients were of both sexes and of all ages from childhood to adult life and represented at least five nationalities. Some were variously employed in different industries, while others did no work. They attended different churches and did marketing in different parts of the town. Milk did not appear to be the vehicle of infection.

The Dry Brook watershed, from which a small portion of the Adams water supply is obtained, was carefully gone over with a representative from the Engineering Division, and a census of its inhabitants was taken, without disclosing anything to account for the cases.

One case was investigated in the family of a milk producer, who himself first informed the health authorities of the presence of the disease. The patient was transferred to a hospital, and no other cases developed. The physician in attendance, who reported the case later was reproached by the producer for not telling him of the nature of the case earlier, so that he might protect his milk supply.

Another case investigated on a milk farm was removed to a hospital. There it was found that it was a case of specific infection rather than typhoid fever. The case was fatal and will undoubtedly add to the typhoid death rate of the community where the patient died.

One carrier case was located during the year. Fortunately the woman's occupation was such that she did not handle milk or food, and but one case, which led to her discovery, could be traced to her.

A total of 36 cases were investigated in detail.

The Wachusett Health District Officer reports that in Ashby there had been no typhoid fever for a considerable number of years until this year. Three cases occurred, 2 of which were in one family, — 1 case a contact. Each had drunk water from a number of questionable sources, including cisterns by the roadside.

Two cases occurring in South Ashburnham were investigated. They were taken ill during the fly season, and lived in a neighborhood where cases occurred the year previous, and in which several unsanitary privies existed.

The town of Ayer had been free from typhoid fever for a period of ten years or more until this year. One case occurred, with probable infection out-of-town while visiting.

A case was investigated in Winchendon in December, 1915, on a milk-producing farm, being ill at the time of arrival from Connecticut. Excellent sanitary provisions prevailed on the place, and every precaution was observed against infection of the milk supply.

A case was investigated in Fitchburg, giving a history of contact with a group of cases at East Deerfield among railroad men. This man was stationed for periods of several days at East Deerfield, and obtained drinking water from the same source as the group of railroad men taken ill with typhoid.

A case was investigated occurring on a milk-producing farm in Bolton. The source of infection was obscure. He was kept in quarantine until a negative bile and blood test was obtained. The cows were transferred to another farm for care and handling, after which the sale of milk was again permitted. On release from quarantine they were returned to the farm and the production of milk and its sale allowed to go on as usual.

A case was investigated at Sterling who had up to the time of being taken ill worked for the water board and on the watershed of the reservoir of Clinton. Recommendations were made for improved sanitation on his premises, which were located on the watershed. They were enforced by the water board.

Two cases occurring in Clinton were investigated in January, 1915. Both appear to have received their infection while out-of-town. Both were cared for at the Clinton Hospital.

Another case, occurring in May, had returned to her home from Connecticut a few days before coming down ill. She was cared for at the hospital.

On September 1 a case was brought into the Clinton Hospital from Lancaster. He gave a history of having drunk water from a number of different sources in the country while going about berrying and fishing.

The only physician resident at Berlin became ill with typhoid October 8. He had visited in Maine late in August and thinks that he was infected there. He was cared for at the Clinton Hospital.

A neighborhood group of 4 cases occurred in Gardner during the month of July. Although all the families took milk of the same

milkman, whose supply was limited to these families, no positive evidence could be found to attribute the cause of the outbreak to any one handling the milk. All cases except one were cared for at the hospital.

A case was investigated in Templeton in October. The young man had visited Worcester and Boston about two weeks before coming down ill, and was probably infected in one or the other place. Sanitary conditions about his home were very good. He was cared for at home, and every precaution taken to prevent the spread of the disease.

At West Boylston an Italian living under conditions conducive to the spread of the disease was taken ill in September. He was immediately removed to a Worcester hospital, and the premises cleaned and disinfected.

A case occurring on a milk-producing farm in Princeton was investigated in August. She had attended college in Boston and presented symptoms of typhoid before her arrival home. Home conditions were excellent, and satisfactory precautions were carried out.

At the time of writing, an outbreak of typhoid fever exists at Ashburnham Center. No reported cases had occurred in this village for more than twelve years until November 5, when several persons showed suspicious symptoms. Up to date, November 13, 16 cases have been reported. The first of the group presented first symptoms October 26, and by November 5, 10 had come under the observation of the physicians, and from November 5 to 13, 6 more were found to present positive symptoms. At the time of writing, no definite conclusion has been reached as to the source of infection. Suspicion points strongly to the water supply.

A State District Health Officer investigated a case in Orange January, 1915. On May 17 he investigated a case in New Salem. Water was obtained from two sources, an open spring and from a well, the latter said to be used only for washing purposes. It was located under the kitchen and dangerously near the privy.

In the Southeastern Health District the total number of typhoid fever cases reported for the year was 429, while the number of cases reported for the same period in 1914 was 336.

Of the 429 cases reported, 4 cities reported as follows:—

New Bedford, ...	153
Fall River, ...	134
Taunton, ...	11
Attleboro, ...	8
	— 306
Out of 64 towns, 27 towns reported, ...	123
Total, ...	429

This disease shows an increase of 93 cases as compared with last year. The greatest number of cases have been reported from New Bedford. The recognition of laboratory aids in the diagnosis of this disease is a matter of great satisfaction to health authorities. It is to be regretted, however, that the neglect to use the antityphoid prophylactic continues to expose the people of the Commonwealth to the ravages of this disease. It is also a source of regret that the convalescence of patients is not followed up as it should be by the use of laboratory aids in determining the extent of possible "carriers" among cases of this disease.

Outbreaks of this disease have occurred in various parts of the district outside of the cities, notably Mansfield, where the outbreaks have been three in number. The first two were covered in reports submitted to the Division, and published in a recent issue of the monthly "Public Health Bulletin" of the State Department of Health. The third outbreak is now being written up. Each one of the outbreaks has been thoroughly and repeatedly investigated, and the epidemiological work carried on persistently and in the right direction. The original source of the disease, diligently traced, was finally located bacteriologically in a certain member of a milk farm family, and promptly recognized as a "carrier." This "carrier," a male, admits having had typhoid fever himself about forty years ago, which admission is supported by the statements of other members of the same milk farm family.

This "carrier" finding has been repeatedly confirmed by consecutive positive bacteriological findings per the bile culture tests, the first fecal specimen being obtained by a lay member of the local board of health, and subsequent specimens being obtained by the chairman of the local board, the laboratory aiding magnificently in determining positives. Since this "carrier" has been kept away from the milk farm, and the milk output therefrom pasteurized, no additional cases have developed.

In these outbreaks the local authorities, the District Health Officer, epidemiologist, the director and bacteriologist of the Department have jointly co-operated in the work of determining the causal factors in this triple series of outbreaks. The difficulties were also greatly increased by the outbreaks recurring in a railroad junction town in connection with a railroad restaurant, and the fact that the male contingent of population was mostly, if not entirely, employed in railroad work of one kind or another. This, of course, necessitated trips out-of-town daily, with food and water consumption elsewhere than in Mansfield. These factors were one by one studied epidemiologically and eliminated.

Conferences between the local authorities, the local physicians and the Division of Communicable Diseases were held, but the full support of the local medical men of the town was not as satisfactory as it should have been.

The townspeople have been somewhat reluctant in the matter of submitting to culture taking and other bacteriological tests, and lukewarm in adopting the antityphoid inoculation treatment. It is still possible that by this time secondary foci of the disease may be operative, and tend to an occasional case in the near or remote future.

Small outbreaks of typhoid fever have also been investigated in quite a number of towns, *e.g.*, Provincetown, Harwich, Barnstable, Plymouth, Dighton, Rehoboth, Swansea and Westport, as follows:—

Provincetown.—An investigation by the State District Health Officer showed that the cause was not definitely determined, although the first apparently recognized case was that of a washerwoman, past middle age, who had been employed to do washing and ironing at a local hotel during June and July, 1915. This woman lived near one of the public schools, the water supply of which was taken from a pump. The woman and school children used the same pump. The consecutive cases developed among the children attending this school, beginning in August and continuing up to November, 1915,—in all about 10 cases. Since then occasional cases have developed as a result of contact. The abolishment of pumps and wells has been urged upon the board of health, and the town water supply extension to schools recommended.

Harwich.—Like investigation, though not conclusive, was pushed to the point of locating a suspected “carrier,” but the application of bacteriological tests to confirm this suspicion was not well received and met with failure, as reports on file show.

Barnstable.—Like investigation showed that the disease was due to importation from without the district.

Marthas Vineyard.—Two cases were located, one in Oak Bluffs and one in Edgartown. Both cases were imported, one from Connecticut and one from Vermont. The cases were isolated and transferred to Boston hospitals.

Plymouth.—Investigation failed to determine the original cause of the disease.

Westport.—The cases were traced to contacts.

Dighton, Rehoboth and Swansea (the 2-mile purchase area).—Contacts and “carriers” have been responsible for continuing outbreaks for several years. The refusal of the residents within this section, bordering on the three towns named, to submit to bacteriological tests, with the neglect of personal hygiene, means expected future

outbreaks and criminal loss of life among the foreign people who inhabit this area.

In the Northeastern Health District a typhoid fever outbreak in Lynn, numbering 23 cases, deserves mention. These cases developed January 1, and ceased March 17, 1915. The cases were located in east, west and Lynn proper, covering fairly well the greater part of the thickly settled section of the city. On the other hand, half of the cases (11) extend in a somewhat irregular line, following in a manner the course of Western Avenue, one of the main streets of the city. With one exception all cases are among persons in comparatively needy circumstances, among whom an indifferent standard of living prevailed.

The conclusion arrived at was as follows:—

1. The only common factor in these cases is that of the milk supply, as it appears that the supply from one milk dealer was used in whole or in part in 18 cases.

2. That milk from another dealer was used in 3 cases.

3. That no milk at all was used in 2 cases.

4. That in 1 case the diagnosis need not be considered.

These facts were brought to the attention of the local authorities.

The District Health Officer for the North Midland District reports that while there has been no large number of cases in any section of the district, there have been rather more typhoid cases than the average in several places. Four cases among the workers in the North Chelmsford Mills came in rapid succession. On investigation it was found that about two weeks before they commenced, there was a gang of imported ice cutters on the pond above the mills and that a toilet used by them was overflowing into the pond near the mouth of the canal. The water was found to be polluted with sewage. Other drinking water is furnished in the mills, but this is used for washing.

No further cases occurred.

Two cases occurred in Tyngsborough. The first was imported, and his wife was a secondary case.

Four cases in Woburn were investigated. The first was found to have come home sick, and the others were probably contacts, as they were intimate and lived in adjoining houses.

Rather more than usual has occurred in Lowell. Early in the season there was a small group that seemed to be possibly connected with a boy selling pop corn from one of the families. Later there was a larger number that lived in one locality. There seemed to be little in common except proximity, and, from the fact that it was in a district of few screens and poorly kept houses, flies might be considered.

In Wilmington there were 4 cases in one family, the first being the mother and 3 secondary cases following. From the large number of secondary cases it would seem that if vaccine were used more as a routine practice when a diagnosis was made of the first case, that the number of cases would be cut down materially.

In the State Reformatory at Concord and the Infirmary at Tewksbury a beginning has been made, especially in immunizing those who handle the food supply, after first taking Widal's.

Another thing that seems to need serious attention in this connection is the summer camp. A surprisingly large number of people are flocking to certain localities, building their houses frequently in as close proximity as city lots, and with no sanitary supervision. Among those who will patronize these places will naturally be a goodly number of invalids and convalescents with infective excretions.

Most gratifying results following a campaign of sanitary engineering and application of the known principles of preventive medicine, are shown by the fact that in 1887 there were 45 deaths per 100,000 population, and in twenty-eight years that number has been reduced to 5.5 per 100,000, — a saving for 1915 of approximately 14,220 people, the largest number of whom would be lost at the most useful period of their lives.

The accompanying letter is an example of a method that has been utilized with good results in calling the attention of local health authorities and practising physicians to the seasonal prevalence of typhoid in the late summer.

DEAR SIRS: — With the advent of the season of the year when typhoid cases frequently prevail, may I ask your active co-operation in an effort to better the showing of the district in this regard? It will be helpful if each physician will promptly report every case brought to his attention, and especially if he will report early all suspicious cases to the local health authorities, in order that precautionary measures may be taken. This is particularly important in case the patient or his family are in any way associated with the handling or distribution of milk and its products, or in the preparation or serving of food.

The State Health Department stands ready to assist at any time through its District Health Officers, and through the furnishing of Widal outfits and bile culture tubes, and the free examination of the same. Typhoid vaccine for immunizing purposes is also furnished and its use encouraged.

Your active interest in this matter will be greatly appreciated, especially the prompt and early report of cases. Such co-operation must eventually bring gratifying results in the reduction of the death rate from typhoid in this part of the State.

Very truly yours,

_____,
State District Health Officer.

TRICHINOSIS.

But one case of this disease was reported, and that was in Pittsfield. Other people who ate the same pork had suspicious illness, but were not reported. This case was confirmed microscopically. This disease is not common in Massachusetts, due probably to the fact that our people eat very little uncooked meat food.

WHOOPING COUGH.

The total number of cases of this disease reported during the year was 6,062. The total number of deaths for the same period was 237. This is a death rate of nearly 4 per cent. This is undoubtedly far below the actual. This death rate is sufficiently important to convince even the community skeptic of the dangers incident thereto. The tendency among the laity to regard this disease as deserving of little parental notice or professional concern is most deplorable. The death rate above shown, however, does not, by any means tell the whole story.

The State District Health Officers have found too often that the medical men who sign the death certificate erroneously attribute the cause as due to the complications rather than the disease itself. The reasons for so doing are obvious, *i.e.*, as a class, medical men are not unmindful of the lay notions and opinions prevalent in certain communities (as to the comparative mildness of this disease), and, to a limited extent, they practically heed them. When they are finally called to a case of this disease, and find complications well advanced and likely to terminate fatally, especially cases that have not had any medical attention whatever, though recognized by the laity, they are not quite willing to be held responsible for losing a case of this disease. Consequently, they diplomatically elect to have the cause of death publicly considered as due to complications commonly regarded or classed as fatal.

The determination of a definite period of isolation or quarantine for this disease is still *sub judice*. Advocates are not wanting on all sides of the question. Some are in favor of one method and some of another. In some towns the houses harboring cases of this disease are placarded by warning notices, as in Provincetown for example, and the individuals kept on the placarded premises. In other towns the cases have been tagged, or have been obliged to wear colored cloth arm bands or badges, designed to warn the public and thus avoid contact.

There are undoubtedly many cases of this disease which are never reported, for physicians are sometimes careless, and in many instances, in which no physician is called, the parents are not yet aware that the disease should be reported.

The State District Health Officers have also found that this disease is one of the least well reported diseases. Neither the public, the parents, the local authorities or physicians appreciate its importance or seriousness.

One State District Health Officer investigated two outbreaks, one numbered 40 cases, the other 17 cases. Neither of these outbreaks was appreciated until the examination of the school children by the school physician proved its existence.

Various outbreaks of this disease have been investigated in all of the health districts. Recommendations have been made to the local health authorities. Various quarantine proposals have been offered to local health authorities. Some have been accepted and applied successfully. Rules have been prepared and advised. Some local authorities have taken the initiative themselves and drawn up various measures for the approval of the State District Health Officers.

INFANT MORTALITY.

This great subject has been receiving more than the usual amount of thought and concern, national, state, public and private. The past year has forced the nations at war to consider seriously all phases of the problem as never before. The non-warring nations have been mathematically estimating the relative importance of the problem as a basis for future calculation of army mobilization as well as economic usefulness. That the tremendous sacrifices of men in war times, with the corresponding family hardships incident thereto, have contributed to the study of the subject, no one can deny. With commendable foresight certain European governments directed their attention to this matter a score or more years ago, with results not to be left out of consideration at the present time.

To such an extent, then, has infant mortality forced the study of its causes upon us, that we are now virtually agreed that any factor which tends to hamper or interfere with living conditions generally must necessarily contribute to a materially increased mortality rate in infants throughout the world.

But it is not alone the warring countries; we must consider countries at peace, — nations, States, cities and towns. Each has its own peculiarly interesting infant death rate, with seldom two exactly the

same. From time to time statisticians have been computing rates and defining causes. There is still room for argument and a large space for facts, *e.g.*, why one section of a country, State, city or town should show variations in mortality rates for infants, under what appears to be a similarity of conditions, has not been answered satisfactorily, and still begs the question. These things are very difficult of explanation. Bringing the matter nearer home, why should we note variant rates even among families where the factors should be the same or nearly so? Reason, observe, study as we will, the solution of the problem is no nearer than before; it is still ahead of us; and like the will-o'-the-wisp the pursuit is both entrancing and interesting.

The public and the health officer look at this subject from two viewpoints: the public, because anything that can be done for the helpless infants arouses tender sympathies; the health officer, because in studying his statistics he usually finds that from one-tenth to one-third of all deaths are under one year of age. Right here it seems that the greatest results in reducing the death rate can be accomplished.

While it is generally known that industrial centers have a high infant mortality, statistics show it to be unusually high in Lowell and Fall River. Especially so when estimated by the number of births reported. Special investigations have been made in Lowell. Theoretically one would say that the high mortality in such a center would be due to a large proportion of bottle-fed babies or at least mixed feeding, owing to ready employment for mothers. With this in view a conference was had with several of the managers of the large mills and a plan was laid before them to set apart a room for a nursery where mothers could bring their babies and have them looked after, and that the mothers be allowed twenty minutes from work in the middle of the forenoon and the middle of the afternoon to nurse them. Some of the mills agreed to do this if we could show that their mothers lost more babies than others. A survey is now being made to try to show this.

The investigation of deaths of infants under one year of age in Lowell for the first ten months of 1915 has been completed since the district report went in; 284 deaths were registered; 74 could not be found or would not give the information asked; leaving 210 for statistical calculations. Of these, 80 were breast fed, 16 could not be determined, and 114 were either bottle fed or had mixed feeding. Of the 210, the mothers remained at home in 110 cases, while 100 mothers worked, leaving the infant to be cared for by others; and

they were of necessity either bottle fed or had mixed feeding under adverse circumstances. During this time about 2,500 births were reported, — actual count, 2,386.

The birth returns are such that it is impossible to estimate the number of operatives; but from a census made of two of the large mills two years ago it is safe to estimate that from these ten corporations there were not more than 200 mothers. These same corporations in this ten months gave a death toll of 69, — nearly a third of the deaths, — while they produced less than one-twelfth of the offspring.

Many statistics have been compiled to show that the cities are fast becoming safer places to bring up children than the country. While we do not wish to detract from the wonderful advancement made in reducing the infant mortality in most cities, it must be remembered that the town with a relatively small population may not represent a truly New England rural condition. It may contain one or more industrial villages, where habitations are crowded and the population made up of a considerable percentage of the poorer class of foreigners, — city conditions of crowding without the corresponding sanitary regulations and conveniences.

CAUSES.

Children dying within the first month after birth are lost largely through prenatal causes. We hope that the free Wassermann test for syphilis, which has been extended by the State Department of Health through the physicians to every citizen of the State, will materially reduce this. We also hope that it will become as common a practice for physicians to take a Wassermann of every woman who comes to him for an obstetrical engagement, as it is to ask her for a specimen of urine. The one insures the child, the other insures the mother. Many an innocent woman is suffering from this disease without any fault of her own or that of her husband. With it she will probably bring forth a weakly child for an early grave. When, if the trouble is discovered in the early months of pregnancy, the treatment is begun at once, there is ample time to cure the mother and at the same time the unborn child.

Chapter 229 of the Acts of 1911, which provides that pregnant women shall not be given employment within two weeks of delivery nor within two weeks after delivery, is practically non-operative for various reasons: (1) because the date is always uncertain; (2) because there may be various reasons for evasion and other reasons for concealment which obviously need not be mentioned.

Births and Deaths in Massachusetts under One Year for 1909-14, inclusive.

YEAR.	Births.	Deaths.
1909, ...	83,471	10,739
1910, ...	85,940	11,656
1911, ...	88,004	10,686
1912, ...	89,839	10,613
1913, ...	90,050	10,238
1914, ...	93,884	9,814

The table shows that material progress has been made in saving the lives of the infants, and that since 1910 it has been progressive. In the six years 1909 to 1914, inclusive, there has been an increase in the registered birth rate of 10,413, and during the same period there has been a decrease in the total number of deaths under one year of age of 925.

EDUCATIONAL WORK.

In this we include the talks given to individuals and groups of people as well as time put in with local officials in explaining all phases of public health work. It may be to mothers in explaining why such and such measures are necessary to be carried out with their children either in child welfare work or in the control of communicable diseases. It may be in management of conditions at their homes or it may be in regard to the schools. It may be to the officers of an antituberculosis league, explaining the local field for their services, or it may be to public officials calling their attention to the fact that the statutes require them to do so and so, why it will be a benefit to their community, and in assisting them to arrange the details.

It is a very necessary part of our work, requiring much time; we know that it accomplishes much good, but it is impossible to give exact details of the results. The State District Health Officer must at all times be able to show that he knows the subject thoroughly or his arguments will fall on sterile soil.

HYGIENE.

During the year a Division has been established under this head. The State District Health Officer has been working with it in investigating conditions, more especially of medical inspection of schools.

A lecture course has been prepared and the State District Health Officers in all the districts have taken part in it to some extent and are expected to do more. Most of the men have taken a very active part in public speaking in the past beyond that required in routine work. We feel that addresses on public health topics are a part of the work of a public health officer, and we are always ready to do our part.

NUISANCES.

Many complaints are received concerning nuisances and all are investigated. Many are real while more are the outcome of neighborhood quarrels. In the past year the various complaints have been on account of —

- Filthy or improperly constructed privies.
- Overflowing cesspools.
- Decayed vegetables.
- Piggeries.
- Improper storage of fertilizer.
- Sink drainage into brooks.
- Manure collections and other filth in thickly settled districts.
- Keeping horse and hens under living rooms.
- Filthy, neglected and poorly managed dumps.
- Dog jumping on passing people, soiling clothes and frightening them.
- Cows in thickly settled places.
- Untidy and noisy stable.
- Noisy and dusty coal conveyors.
- Polluted pond waters.
- Unsanitary well locations.
- Fish carcasses on shores.
- Foul accumulations of waste waters.
- Clam shells and fish offal within low water mark.
- Dead pigs on private land.
- Sanatoria tuberculosis patients lounging and spitting on private premises.

The State Health Department has no jurisdiction in this matter. The statutes distinctly designate other departments for appeal from the decision of the local board of health. While the law remains as it is there seems to be considerable question whether it is wise for us to shoulder the responsibility of being accused by the local board of health of interfering in something over which we have no jurisdiction as well as the enmity of one of the disputants, although we are usually able to correct the evil if one exists.

While the State Department and its representatives have no power

in the matter of nuisances, the local boards of health have full power. It is with these boards that we are dealing daily, and it is to us that they are accustomed to come for advice, sympathy and help in these as well as other problems. In nuisances we are officially impotent. As we have no official power, should we give even an opinion as officials?

POLICE STATIONS, LOCKUPS, HOUSES OF DETENTION.

The State District Health Officers report poor conditions in many of the police stations and lockups, more especially in the smaller towns. Considerable difficulty is found in securing standards by which the police stations or lockups in any community may be judged.

For this reason we would suggest that during the coming year a careful survey be made of all police stations and lockups in the Commonwealth. This study to take into consideration the population served, the average number of arrests each year for five years, the average and longest period of detention of prisoners, the existing accommodations at each police station or lockup, including fire protection, and the care or neglect of prisoners while locked up. From the results of such a study it would be possible to designate a minimum standard for all police stations and lockups. With the enactment of such a standard into law, it would be possible to improve materially existing conditions among many police stations and lockups in the State.

The following is a tabulated list of the number and condition of police stations and lockups in the State:—

Number in the State, ...	257
Number examined, ...	239
Number found satisfactory, ...	203
Number found unsatisfactory, ...	50
Number condemned, ...	5
Number abandoned, ...	11
Number authorities notified, ...	34

JAILS, PRISONS, HOUSES OF CORRECTION, REFORMATORIES, ETC.

These institutions are under the control of State or county authorities, and are all clean, well-kept places. They are always ready to consider any suggestions to improve conditions. In some of the county jails there is little work for the prisoners. In looking at these able-bodied men it seems as though there was much energy that

should be put to use, and at the same time it would be better for the men.

The following table shows the number and condition of such places.

Number in the State, ...	24
Number examined, ...	22
Number satisfactory, ...	24
Number unsatisfactory, ...	—

A list of such institutions within the State is as follows: —

List of Jails, Houses of Corrections, Prisons and Reformatories.

Barnstable County Jail and House of Correction, ...	Barnstable.
Berkshire County Jail and House of Correction, ...	Pittsfield.
Bristol County Jail, ...	Taunton.
Bristol County Jail and House of Correction, ...	New Bedford.
Dukes County Jail, ...	Edgartown.
Essex County Jail and House of Correction, ...	Salem.
Essex County Jail and House of Correction, ...	Lawrence.
Essex County Jail, ...	Newburyport.
Essex County Jail and House of Correction, ...	Ipswich.
Franklin County Jail and House of Correction, ...	Greenfield.
Hampden County Jail, ...	Springfield.
Hampshire County Jail and House of Correction, ...	Northampton.
Middlesex County Jail and House of Correction, ...	E. Cambridge.
Middlesex County Jail and House of Correction, ...	Lowell.
Nantucket County Jail and House of Correction, ...	Nantucket.
Norfolk County Jail and House of Correction, ...	Dedham.
Plymouth County Jail and House of Correction, ...	Plymouth.
Worcester County Jail, ...	Worcester.
Massachusetts Reformatory, ...	Concord.
Reformatory Prison for Women, ...	Sherborn.
Prison Camp, ...	Rutland.
State Farm Prison, ...	Bridgewater.

WATER SUPPLY AND SEWERAGE.

Work in this line is done almost entirely in conjunction with the Engineering Division. The State District Health Officer furnishes the medical statistics about a given source of danger and either takes the sample or goes with some representative of the Engineering Division while he does it.

Many polluted wells are found in the country districts, owing to lack of sanitary consideration in locating them. If arrangements can

be made so that a sufficient force can be used to analyze these private sources, we are sure much good can be accomplished. The people are not unmindful of the desirability of having their wells tested if they have the opportunity of so doing without seeking out a private chemist. They have occasionally been frightened by exorbitant charges.

In December, 1914, a circular letter was received from the Commissioner of Health setting forth the danger from the use of water from depleted private water supplies, caused by the deficient rainfall of the preceding few months. Copies of the circular were sent to the local health authorities of each city and town within the districts, advising them to bring the matter to the attention of the people in their respective communities. The number of replies received from the communities showed that the advice contained in the circular had been reasonably well published. As a result of this advice a large number of private and semipublic water supplies have been examined and analyzed upon the recommendation of the District Health Officers or upon the initiative of the local health authorities.

Water supplies have been investigated at schools in Wilmington, Dracut and Tewksbury, and in most cases found to be polluted.

Three cases of lead poisoning were found in one house in Tyngsborough. Their supply came through several hundred feet of lead pipe, and the water was found to contain a dangerous amount of lead.

The new filter plant for the boulevard wells in Lowell is about ready to be put in operation for removing the excess of iron and manganese from the water. When this is done, it is to be hoped that Lowell will no longer think it necessary to run the Cook wells, an often demonstrated source of lead poisoning when drawn through a lead service.

That this circular with its advice was timely is shown by the following instances:—

Two springs at Westminster, a considerable distance from No. 4 school building, the water of which is used for drinking by the school children, were examined. The water from each spring was found on analysis to be safe for drinking. It was suggested, however, that after proper protection from surface drainage and visitors had been taken that the water of one of the springs could be piped to the school building without difficulty.

Two wells located in Sterling were examined and the water from each analyzed. Well No. 1 was located on the premises of a milk-producing farm furnishing milk to the family on the premises of

Well No. 2, upon which a case of typhoid fever occurred. Well No. 1 was found to be grossly polluted, while No. 2 proved to be a safe supply.

The well at the Elm Street School, Baldwinsville, was examined, and the water analyzed. The results showed it to be badly polluted and unsafe for drinking.

Two wells located at Winchendon were examined and analyzed, one showing considerable pollution, while the other was found to be of good quality for drinking.

A well located at South Bolton, the water of which had been suspected of causing intestinal disturbance in members of the family using it, was analyzed. With better protection against surface drainage and removal to a greater distance from other possible sources of pollution, it was thought the water would be safe for drinking.

A well located at Gardner was examined and the water analyzed. The results showed it to be grossly polluted and unsafe for domestic use.

A well located in the village of Hubbardston was examined. The water was found to be unfit for domestic use. With certain changes for the protection of surface drainage and removal to a greater distance from other possible sources of pollution, it was thought that the quality of the water would improve and become suitable for drinking.

At Ashburnham it was found that bathing in the public water supply — Naumkeag Lake — had not been prohibited. The law relative to bathing in public water supplies was called to the attention of the local water commissioners. Immediately afterward the banks of the lake were posted, prohibiting bathing and quoting the law relative thereto.

Samples of water from the Hoosick River at Williamstown and from the Williamstown water supply have been taken regularly for the Division of Engineering.

Several visits of inspection were made to the new Beaman basin of the North Adams water supply during its construction. This reservoir is now complete and in use.

The inspection of the watershed of Dry Brook, a part of the Adams water supply, is mentioned elsewhere.

Samples of water for analysis were taken in North Adams, Adams and West Stockbridge.

CLERICAL WORK.

In the districts with a large population there is necessarily a large amount of correspondence. As his services are usually required in the field all day, much of this is either neglected or done at a time when the State District Health Officer is too tired to do it as it should be done. This is well summed up by one of the State District Health Officers in a large district, who says: "Each District Health Officer should be relieved of the tiresome details of clerical work. For a man to spend all day in the field each day of the week is enough without requiring him to sit at his desk all the evening. It cannot be said in answer to this, take a day off once in a while and clean up your written work. When the day is ready, the details of work done some days before are stale. The time to make a record of work done is within a few hours after it is performed. The assistance necessary may be given by a competent stenographer or a nurse in the employ of the State Department of Health. It is not always practical to secure the services of a stenographer at the time when she is needed. It would be practical to secure the services of a nurse in such a manner that part of her time would be given to clerical work."

TRAVEL.

The automobile has been found a great saver of time, and now all the District Health Officers are furnishing machines, being reimbursed at the rate of 8 cents a mile. Some of the District Health Officers are of the opinion that this rate does not adequately reimburse them, but are forced to continue it from a personal satisfaction in the knowledge of more work performed in a given period of time than otherwise.

Many of the places to which they go require but a small portion of the day, and then frequently more than one place in a city or town must be visited. With an automobile, and planning one's work well, it is safe to say that nearly double the work can be done in a day's time. Much time would be wasted in waiting for steam and electric car schedules, routes are often circuitous, and one District Health Officer reports 21 towns in his district that have communications over the highway only.

SUGGESTIONS.

The cities and towns are fast learning the value of investigating and stamping out communicable diseases, especially diphtheria, among school children and of keeping the schools open. All children in infected rooms are cultured, and, where possible, absentees are looked up. It has been found that this work, if done thoroughly, is a great aid in quickly controlling the disease by picking up the carriers. This has brought much additional work to the State laboratory. While we realize fully that the laboratory force is working with a high percentage of efficiency, it is not always able to handle the work with the dispatch the local authorities would wish. We believe it is work that should be done, and it would be well worth the expenditure of an additional appropriation, to provide ample room and laboratory force to handle this work with dispatch. While it may be said that it is not emergency work, it is work that must be done quickly, to inspire the confidence of the public in allowing their children to continue at school.

DIVISION OF BIOLOGIC LABORATORIES.

DIVISION OF BIOLOGIC LABORATORIES.

DIRECTOR AND PATHOLOGIST, M. J. ROSENAU, M.D.

Dr. ALLAN J. McLAUGHLIN, *Commissioner of Health.*

SIR: — I have the honor to submit the following report of the Division of Biologic Laboratories for the year ending Nov. 30, 1915.

Respectfully submitted,

M. J. ROSENAU,
Director and Pathologist.

REPORT OF THE DIVISION OF BIOLOGIC LABORATORIES.

The duties of the Division of Biologic Laboratories consist in manufacturing certain biological products and in making certain specific tests useful in the prevention, cure and recognition of serious infections, such as diphtheria, epidemic cerebro-spinal meningitis, syphilis and smallpox. The serums and vaccines produced and the diagnostic tests made in the laboratories of this Division all involve highly specialized and exacting technical manipulations. The principal products made and distributed are diphtheria antitoxin, antimeningitic serum, vaccine virus and typhoid prophylactic; the principal tests made are the Wassermann reaction and the Schick reaction. The services rendered are free to residents of the Commonwealth.

ORGANIZATION.

There are two distinct laboratories in this Division: (1) the Antitoxin and Vaccine Laboratory at Forest Hills; (2) the Wassermann Laboratory at 240 Longwood Avenue. The director of the Division has general supervisory charge of the policies, personnel and the work. Each laboratory is placed in immediate charge of an assistant director, — Dr. Herbert R. Brown of the Antitoxin and Vaccine Laboratory, and Dr. W. A. Hinton of the Wassermann Laboratory.

DIPHTHERIA ANTITOXIN.

Diphtheria antitoxin is both a preventive and curative agent of great potency. Of diphtheria antitoxin 203,954 doses¹ were made and distributed during the year at a cost of about $8\frac{1}{2}$ cents per dose, and distributed in 72,835 bottles, or separate packages. In plain figures, 175 gallons of diphtheria antitoxic serum were made and distributed. The production of this large amount of serum taxed the capacity of the laboratory.

If every case of diphtheria were given an injection of diphtheria antitoxin within the first twenty-four hours of the disease, there would be practically no deaths from this infection. Emphasis is laid

¹ A dose represents 1,000 units.

upon this point, for there are still an unnecessary number of deaths from diphtheria. Thus there were 652 deaths from this disease in 1914 and 579 in 1915 in Massachusetts. Many of these precious lives could have been saved by the timely use of this sovereign remedy. Time is the great factor in saving lives in diphtheria. The antitoxin should be given early. After the damage is done it may be too late, for the antitoxin cannot be expected to quicken nerve cells that have been killed by the toxin. Both the medical profession and the public should be made to realize the importance of the *early* administration of diphtheria antitoxin in all cases, or suspected cases of the disease.

The yield of diphtheria antitoxic serum has been practically doubled by bleeding the horses more frequently. By this simple procedure, and without any increase in cost, we have been able to meet the growing demand for diphtheria antitoxin during the past year.

THE SCHICK REACTION.

The Schick reaction is a skin test used to determine whether the individual examined is immune or susceptible to diphtheria. It is made by injecting a small amount of diphtheria toxin into the skin. The amount injected is one-fiftieth of a minimum lethal dose for a 250-gram guinea pig. The toxin is a very potent poison and must be standardized with precision for this purpose.

The Schick reaction serves as a reliable clinical aid in selecting the individuals who need protective injections of diphtheria antitoxin after they have been exposed to diphtheria. The use of this test results in a great saving of antitoxin and avoids the inconvenience of injecting it into persons in whom it is not necessary, particularly in the homes among the relatives of one suffering from diphtheria; also in schools and orphan asylums during an outbreak of the disease; and as a routine procedure on patients, nurses, doctors, ward tenders and others in contagious hospitals. Health officers will find it an advantage to use the test as an aid in stamping out outbreaks of diphtheria. The laboratory is prepared to demonstrate to physicians, health officers and others how to use and interpret the Schick reaction.

ANTIMENINGITIS SERUM.

Antimeningitis serum gives good results as a curative agent, but is not used as a preventive. The laboratory was requested to furnish some of the surplus supply of this serum for the use of the armies in the European war. This offer was declined for the reason among others that we produce just about enough for the needs of the State.

There has been comparatively little epidemic cerebro-spinal meningitis in Massachusetts during the past year, and therefore the demand for this serum has not been great. A total of 16,500 cubic centimeters was made and distributed in 1,100 separate packages containing 15 cubic centimeters each.

In the interest of preparedness, we look with concern to the possibility of an increase in the amount of cerebro-spinal meningitis in this country following the war, and we therefore have at present four horses in active process of immunization which will permit us to obtain a surplus supply, in order to meet an emergency. Should this disease break out in Massachusetts, we could also prepare at comparatively short notice a vaccine which has been used with success as a protective inoculation.

TYPHOID PROPHYLACTIC.

Typhoid "vaccine" used as a preventive inoculation against typhoid fever is no longer an experiment. Its protective value has been demonstrated on a large scale in the United States Army and also in civil life. Its use is voluntary, but its benefits are appreciated by an increasing number of persons. Thus we produced and distributed during the year 31,355 ampoules, each containing 1 cubic centimeter. This is more than 6,000 doses in excess of the amount distributed the previous year.

The injection of this vaccine under the skin always produces a local reaction and sometimes a general reaction, which, however, is never serious. No harmful results are known to follow the use of this protective substance. It has been used especially to immunize nurses, ward tenders, doctors, travelers, campers and others who are particularly exposed. All persons in the household of a bacillus carrier, as well as all persons within the infective reach of such a carrier, should be protected with the typhoid prophylactic. It is also useful to check outbreaks in institutions. The protection lasts for about two years, and may be renewed. Persons who are protected should not be reckless, for a small percentage of those exposed to the infection contract the fever despite the prophylactic vaccination. In such cases, the disease is apt to run a mild course.

VACCINE VIRUS.

The production of vaccine virus was attended with unusual difficulties this year, on account of the outbreak of the foot-and-mouth disease, which rendered it difficult and at times impossible to obtain

calves to use for propagating this material. Furthermore, a large amount of vaccine virus which had been prepared was destroyed in order to make assurance doubly sure. A total of 139,140 doses of vaccine virus were made during the year, of which 104,922 were sent out.

Vaccination for smallpox remains the first and greatest single protective measure of a specific nature given to man. The experience of over one hundred years — since Jenner — has fully confirmed his claim that it protects against smallpox as much as that disease itself will. The greatest care is necessary to insure the potency and purity of the product. Every known safeguard and every known laboratory test is applied to each lot of vaccine virus before it is issued. After these tests are completed, a sample lot of ten tubes is given to one of the District Health Officers to determine the potency and quality of the take in ten primary vaccinations. At present, this work is being done by Dr. Champion. Similar tests are also made under the supervision of the chief of the Division at the Children's Hospital and elsewhere.

The package in which the vaccine virus is distributed has been improved and cheapened, and the circular of instructions has been rewritten. Attention has been called particularly to the importance of using a proper method of vaccination, that by incision or scratch being recommended. The old method of scarification is considered unsafe and unsatisfactory in that it invites infection.

WASSERMANN TEST.

The Wassermann test is a highly complex technical procedure designed to recognize the presence or absence of specific bodies in the blood or cerebro-spinal fluid. If these bodies are present, it indicates that the person has syphilis; if absent, it suggests the absence of the disease or its cure. The test is, therefore, a diagnostic method useful in the prevention as well as in the treatment of this infection. The Wassermann Laboratory was opened on the first of June, 1915, during which month 631 tests were made. The number rapidly increased, until now an average of over 2,000 a month is made. The number is gradually increasing and will soon tax the capacity of the laboratory force.

The uses and limitations of the Wassermann test are now clearly determined, and it should become a routine procedure in the control of syphilis. The services of the Wassermann Laboratory have been useful to the following groups: —

Insane.

The Wassermann reaction assists in the diagnosis of general paresis, which is one of the consequences of syphilis and one of the most serious forms of insanity. A number of cases not recognized from clinical symptoms were disclosed by a positive reaction. Directly as a result of this work among the insane, the State Board of Insanity has engaged an expert to institute specific treatment in all cases of syphilis under its jurisdiction. Furthermore, Dr. Fernald of the Massachusetts School for Feeble-minded at Waverley has started an investigation of all cases in his institute which are reported as positive to the Wassermann reaction.

Tuberculosis.

Persons admitted to tuberculosis sanatoria will not, as a rule, acknowledge having had syphilis, but frequently admit the fact after a positive Wassermann reaction. Such information is very helpful in the treatment of the case. The test should be applied as a routine procedure in all State and local tuberculosis sanatoria.

Penal Institutions.

The examination of a large number of persons in such institutions has disclosed 25 per cent. giving positive Wassermann reactions in the males and 30 per cent. in the females. This large percentage of syphilitics among the criminal type has a deep significance. Very few of these people admit having had the infection when queried by the examining physician, and the facts would not be known without the Wassermann reaction.

Cancer.

Occasionally syphilis is mistaken for cancer. The diagnostic help afforded by the Wassermann test in such cases is of enormous importance to the individual. The laboratory makes these tests as a routine for the patients in the Huntington Memorial Hospital, etc.

Pregnancy.

The Wassermann test is made as a routine test upon all women under the charge of the Boston Lying-in Hospital and the New England Hospital for Women and Children. In case the reaction is positive, treatment is given, thus preventing the tragic consequences of

hereditary syphilis in the offspring. This is an example of wise prenatal work, which should be widely extended and applied as a routine measure in private as well as institutional practice.

Children's Hospitals.

Children's hospitals, such as the Boston Floating Hospital, the Children's Hospital and the Infants' Hospital, send many specimens to the laboratory for a Wassermann test. This source of specimens has been encouraged on account of its public health importance, and the assistant director of the laboratory has visited a number of such hospitals, as well as a number of State institutions, in order to demonstrate the method of obtaining specimens of blood upon which the test is made. This is part of the educational activities of the Division.

Local Boards of Health.

Local boards of health apparently are not alive to the importance of the service rendered by the Wassermann Laboratory, and should make more use of the advantages offered. It is also recommended that the State Department of Health employ a skilled agent to follow up cases which give a positive reaction, in order to be sure that effective treatment is promptly administered. In the interests of public health, the Commonwealth would be justified in furnishing such services free of charge.

State Institutions, etc.

Every State institution and every private hospital has been offered the facilities of the laboratory, but not all have accepted the service. Any private physician can have the test made through the District Health Officer or the local board of health, or by sending the patient to the laboratory. The number of cases thus examined is showing an encouraging increase as the work becomes better known.

RECOMMENDATIONS.

1. Economy and efficiency in the distribution of the products produced by the Antitoxin and Vaccine Laboratory. This is important in order to prevent waste and also to insure the proper use of the materials. Furthermore, the State is entitled to receive in return for the free distribution of its biological products a complete report upon each case. Such a collection of material would be exceedingly valuable. I would recommend that a station for the distribution of toxins,

vaccines, etc., be established in each sanitary district under the immediate charge of the District Health Officer.

2. A centralization of the laboratories would increase efficiency and also be in the interest of economy. This, however, would require a large original expenditure.

3. The employment of a physician skilled in the administration of salvarsan and a knowledge of syphilis, to follow up cases showing a positive Wassermann and to administer the substance free of charge. Such a person could furthermore be the center for a propaganda for the control of syphilis.

4. Other tests, such as the complement fixation test for glanders and gonorrhœa, and also other diagnostic procedures such as rabies, could readily be added to the duties of this Division with a very slight increase in expenditure.

5. With the strictest economy it will be necessary to have an increase in the appropriation of \$2,500 in order to carry on the work of the Antitoxin and Vaccine Laboratory. This is due to the increase in the cost of feed and other materials, the increased production and demands upon the laboratory, and the increase in the wages account.

A summary with details of the work of the separate laboratories follows.

M. J. ROSENAU,

Director and Pathologist.

WASSERMANN LABORATORY.

The State Wassermann Laboratory was established June 1, 1915, by the State Department of Health, with the following organization: a director, an assistant director, a technician, a stenographer and a laboratory attendant. On this date a circular letter was sent to each of the District Health Officers and each of the institutions under the control of the State Board of Charity, the State Board of Insanity and the Board of Prison Commissioners, together with the secretaries of these Boards, announcing the fact that the State was offering free Wassermann service. Since this time specimens have been examined as follows: June, 631; July, 986; August, 1,036; September, 1,126; October, 1,511; and November, 1,201, making a total of 6,491.

The following gives the classification of the results obtained:—

	RESULTS.			
	Positive.	Negative.	Doubtful.	Unsatisfactory.
Blood, ...	653	4,800	360	126
Spinal fluid, ...	127	348	47	8
Total, ...	780	5,148	407	134

Insufficient serum or spinal fluid for test, 22.

During its first month the laboratory examined specimens for 10 State institutions, 2 private hospitals and 1 local board of health. It has now tested specimens from 15 State institutions, 25 private hospitals, 8 local boards of health and 2 city institutions.

A paper was prepared for the July issue of the "Public Health Bulletin" which announced free service to private physicians and gave directions for obtaining such service. At the same time a clinic was established in the laboratory, where specimens of blood could be obtained from patients upon the recommendation of their physician. As a result of this announcement, during the period from July to November 1, 32 specimens were received through four State District Health Officers, District 4 leading with a total of 27 specimens, and

42 patients were referred to the laboratory for the test, thus making a total of 74 specimens which were tested on the recommendation of 39 physicians.

From November 1 to December 1 a total of 55 specimens were obtained from private physicians, submitted by the direction of six State District Health Officers, District 4 again leading with 36. During this same period 142 patients were referred to the laboratory by private physicians, and 71 physicians, who had never applied before, sought the services of the laboratory. Hence it will be noted that there has been growth not only with regard to the number of cases tested but also with respect to the number of private physicians and private institutions availing themselves of this service.

Since the establishment of the laboratory, we have collected 1,179 specimens of blood from 11 institutions. At the same time the technique of obtaining blood was demonstrated to the District Health Officers and to physicians in a number of institutions.

During the first five months 5,290 tests were made, and the following table shows the analysis of these tests on 4,223 patients. The largest number is from the Psychopathic Hospital, where 1,824 tests were made on 1,144 patients.

TABLE 1.¹—Summary of Cases with Wassermann Results.

COLUMNS.														
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	
<i>Psychopathic Subjects.</i>														
Boston State Hospital,	2	2	3	-	3	2	-	3	28	-	-	-	-	
Psychopathic Hospital, ²	15	43	41	13	6	6	1	9	15	675	11	22	1	
Psychopathic Hospital, Out-patient Department, ²	10	15	-	-	6	4	-	4	5	254	6	-	4	
Danvers State Hospital, ²	3	10	23	11	2	3	1	-	2	236	8	-	1	
Worcester State Hospital, ²	1	8	2	1	2	-	-	-	1	61	2	-	1	
Grafton State Hospital, ²	-	8	-	-	-	-	-	-	3	87	-	-	-	
Taunton State Hospital,	1	3	6	4	2	1	-	2	3	75	1	-	-	
Medfield State Hospital,	-	12	1	2	1	1	1	1	44	189	1	-	-	
Total,	32	101	76	31	22	17	2	16	36	1,605	29	22	7	1,997
<i>Hospital for Inebriates.</i>														
Ring Sanatorium,	-	-	-	-	-	-	-	-	-	3	-	-	2	-
Total,	-	-	-	-	-	-	-	-	-	3	-	-	2	5
<i>Feeble-minded and Delinquent Subjects.</i>														
Industrial School for Girls, ²	14	16	-	-	-	1	11	5	5	268	-	-	-	-
Massachusetts School for Feeble-minded, ²	-	14	-	-	-	-	-	-	19	325	-	-	1	-
Total,	14	30	-	-	-	1	11	5	24	593	-	-	1	679

Criminal Subjects.

Massachusetts Reformatory, ²	16	3	-	-	-	2	1	3	13	-	45	-	-	-	-
Reformatory for Women, ²	7	16	-	-	-	2	3	1	3	9	51	-	-	-	-
State Farm (Bridgewater), ...	-	4	-	-	-	-	1	-	-	-	2	-	-	2	-
State Prison, ...	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Total, ...	23	23	-	-	-	4	4	4	16	9	98	-	-	4	185
<i>Tuberculous Subjects.</i>															
State Sanatorium for Incipient Tuberculosis, ²	-	16	-	-	-	-	-	-	-	-	284	-	-	-	-
Boston Consumptives Hospital, ²	-	18	1	-	-	-	2	1	1	4	99	-	-	-	-
North Reading State Sanatorium, ...	-	-	-	-	-	1	-	-	-	1	2	-	-	2	-
Westfield State Sanatorium, ...	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Total, ...	-	34	1	-	-	1	2	1	-	5	386	-	-	3	432
<i>Cancer Group.</i>															
Huntington Memorial Hospital, ²	1	-	-	-	-	-	-	-	-	-	19	-	-	1	-
Total, ...	1	-	-	-	-	-	-	-	-	-	19	-	-	1	21
<i>Acute General Hospitals.</i>															
Cambridge Hospital, ²	3	2	-	-	-	-	1	-	-	3	73	-	-	-	-
Lowell Corporation Hospital, ²	12	11	-	-	-	1	-	-	1	5	128	1	-	44	-
Melrose Hospital, ...	1	2	-	-	-	1	-	-	-	1	18	-	-	1	-
Boston Dispensary, ...	10	2	-	-	-	3	-	2	4	7	45	-	-	-	-
Salem Hospital, ...	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-
Lynn Hospital, ...	3	4	-	-	-	-	4	-	-	2	10	-	-	3	-
New England Hospital-Dispensary, ...	-	1	-	-	-	-	-	-	-	-	3	-	-	-	-
Total, ...	29	22	-	-	-	5	5	2	5	19	280	4	-	48	419

¹ Data for November are not included.² Institutions which make a routine Wassermann examination on each patient admitted.

TABLE 1.¹—Summary of Cases with Wassermann Results — Concluded.

COLUMNS.													
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
<i>Pregnant Group.</i>													
Boston Lying-in Hospital, ²	-	-	-	-	-	-	-	3	121	-	-	-	-
New England Hospital, ²	-	-	-	1	-	-	-	1	38	-	-	1	-
Total, ...	-	-	-	1	-	-	-	4	159	-	-	1	172
<i>Infants and Children.</i>													
Boston Floating Hospital, ²	2	-	-	-	-	-	-	-	21	-	-	-	-
Children's Hospital,	9	2	4	3	-	-	2	1	54	6	3	-	-
Infants' Hospital,	1	1	-	-	-	-	-	1	26	-	-	-	-
Total, ...	12	3	4	3	-	-	2	2	101	6	3	-	136
<i>Chronic Disease Group.</i>													
House of the Good Samaritan,	-	-	-	-	-	-	-	-	3	-	-	-	-
Channing Home,	-	-	-	-	-	-	-	-	3	-	-	-	-
Robert Brigham Hospital,	1	1	-	1	-	-	-	-	7	-	-	-	-
Long Island Hospital, ²	20	10	-	8	-	1	6	2	112	-	-	2	-
Total, ...	21	11	-	9	-	1	6	2	125	-	-	2	177
Total for each column, ...	132	231	81	31	45	29	50	101	3,369	39	22	71	4,923

¹ Data for November are not included.² Institutions which make a routine Wassermann examination on each patient admitted.

- Column I. Cases of syphilis in whom a history of this disease was obtained and who gave a positive Wassermann test.
 Column II. Unsuspected cases of syphilis discovered by the Wassermann test and corroborated clinically.
 Column III. Cases of general paresis, tabes, tabo-paresis, or cerebro-spinal syphilis in whom a history of syphilis was obtained and who gave a positive Wassermann test.
 Column IV. Cases of general paresis and in a few instances of cerebro-spinal syphilis and tabes discovered by the Wassermann test and corroborated clinically as belonging to this group.
 Column V. Cases with a history and diagnosis of syphilis which were not found positive or doubtful by the Wassermann test.
 Column VI. Cases of known syphilis which gave a doubtful reaction.
 Column VII. Cases of treated syphilis which gave a doubtful reaction.
 Column VIII. Cases of treated syphilis who gave a negative reaction.
 Column IX. Cases doubtful both by the Wassermann test and clinically.
 Column X. Negative cases, presumably nonsyphilitic.
 Column XI. Cases clinically diagnosed syphilis or suspected of having the disease but which were proven otherwise after one or more negative Wassermann tests in each case.
 Column XII. Cases clinically diagnosed chiefly as general paresis and occasionally as cerebro-spinal syphilis in whom repeated Wassermann tests eliminated syphilis as a cause of the symptoms found.
 Column XIII. Cases in which the Wassermann examination was unsatisfactory.
 Column XIV. Total number of patients examined in each group by the Wassermann test to Nov. 1, 1915.

PSYCHOPATHIC SUBJECTS.

An inspection of column II. shows 101 cases of unsuspected syphilis in this group which were discovered after the Wassermann report was made. Columns III. and IV. are interesting because 76 cases were diagnosed as general paresis or cerebrospinal syphilis either on the history or the symptoms, wherefore 31 additional cases were diagnosed as paresis (always of syphilitic origin) or cerebrospinal syphilis, after the Wassermann report was rendered. Column XII. is noteworthy in that 22 cases which gave clinical symptoms of general paresis were determined to be nonsyphilitic by repeated negative Wassermann examinations. Further the diagnosis in most of the institutions can be made with the aid of the Wassermann reaction within five days of the arrival of the patient in the hospital, thus making possible a proper and rapid disposition of the patients.

The State Board of Insanity has recently appointed an expert to investigate and treat those afflicted with syphilis in our State insane institutions. This work could not be done adequately unless Wassermann examinations were made.

DELINQUENT AND FEEBLE-MINDED SUBJECTS.

Here again we see the value of the Wassermann test in the diagnosis of cases not suspected of syphilis. A comparison of columns I. and II. illustrates this point. Data are accessible in this laboratory which show that there is little or no connection between syphilis and organic involvement of the central nervous system such as is found in individuals who are hydrocephalic or who belong to the various types of spastic paralysis accompanied by feeble-mindedness.

CRIMINAL SUBJECTS.

Inspection of column II. shows that 23 cases of syphilis out of a total of 74 syphilitics were only diagnosed after a positive Wassermann reaction. Further it will be noted that this is a highly infected group, yielding 40 per cent. of syphilitics and 4.8 per cent. of doubtful cases in a total of 185 inmates.

TUBERCULOUS SUBJECTS.

Out of a total of 432 cases of tuberculosis 39 (9 per cent.) also had syphilis, and 34 of these cases gave no history or clinical evidence of the disease until a positive Wassermann reaction was found.

PATIENTS SUFFERING WITH MALIGNANT DISEASE.

This group is largely interesting because the Wassermann test excludes syphilis as a cause of symptoms which might otherwise be those of some malignant growth. The laboratory has urged all physicians and institutions to make a routine Wassermann examination on every patient who clinically appears to be suffering from a malignant growth.

ACUTE GENERAL HOSPITAL PATIENTS.

As this title indicates, persons suffering from all manner of acute disease are admitted to these hospitals for observation and treatment. A glance at columns I. and II. will again show how strikingly valuable the test has been in the identification of unsuspected syphilitics. Further, it is important to notice that roughly one-sixth of all patients admitted to this type of hospital had syphilis as a direct cause of their symptoms or as a complication.

GROUP OF PREGNANT WOMEN INCLUDING NEW-BORN INFANTS.

During the past two months the laboratory has made arrangements with the Boston Lying-in Hospital and the New England Hospital whereby in the former instance a Wassermann test is made as a routine on all patients admitted to the pregnancy clinic, and in the latter case whereby blood is obtained from the afterbirth of each mother (fœtal blood). In neither of these groups had a history of syphilis been obtained, and yet an inspection of column II. shows that it sometimes exists. Whenever a positive Wassermann reaction is obtained in any of the patients, these hospitals recommend anti-syphilitic treatment.

SYPHILIS IN PATIENTS UNDER TWELVE.

Although the number of specimens submitted is small, inspection of columns I. and II. shows that the Wassermann test has its value in this group, while column XII. shows its value in the exclusion of syphilis as a cause for the symptoms observed. This group, taken in connection with a study of the specimens from infants, gives a continuous story of the applicability of the Wassermann test in all stages of congenital syphilis.

PATIENTS SUFFERING FROM CHRONIC DISEASE.

The Long Island Hospital group is suggestive of the incidence of syphilis in our chronic almshouse class. Roughly, 26 per cent. of the patients in this group are infected, and column II. again shows a high percentage of unsuspected syphilitics.

The following gives a résumé of 4,218 patients examined by the Wassermann test from June 1, 1915, to Nov. 1, 1915: —

CLASSIFICATION OF PATIENTS EXAMINED.	Patients examined.	SYPHILITIC PATIENTS.		PATIENTS GIVING A DOUBTFUL WASSERMANN TEST AND A NEGATIVE OR DOUBTFUL CLINICAL HISTORY.		PRESUMABLY NONSYPHILITIC PATIENTS.	
		Num- ber.	Per Cent.	Num- ber.	Per Cent.	Num- ber.	Per Cent.
Psychopathic patients, ...	1,997	298	14.8	36	1.8	1,665	83.4
Feeble-minded and delinquent subjects,	679	61	9.0	24	3.5	593	87.5
Criminal subjects, ...	185	74	40.0	9	4.8	98	55.2
Tuberculous subjects, ...	432	39	9.0	5	1.2	386	89.2
Cancer group, ...	21	1	4.8 ¹	—	—	19	97.2
Pregnant women, ...	172	8	4.7	4	2.3	159	93.0
Infants and children, ...	136	24	18.5	2	1.5	107	80.0
Acute general hospital group, ...	419	68	16.2	19	4.5	284	79.3
Patients suffering from chronic disease, .	177	48	26.1	2	1.2	125	72.9
Total, ...	4,218	621	15.0	101	2.4	3,427	82.6

¹ Patient had syphilis of liver and not cancer.

POLICIES.

The laboratory has established the following policies for the present: —

1. *Diagnosis of Syphilis by the Wassermann Test.* — It is the policy of the laboratory to aid physicians and institutions in every possible way, in the diagnoses of syphilis by this test. Further, it desires to encourage co-operation with local boards of health whereby they may become centers for the collection of specimens. This would render the service more accessible to physicians in all parts of the State. Such co-operation could be effected by appointing certain days on which specimens of blood could be obtained from patients by the local health officers on the recommendation of private physicians; these

specimens could then be sent to the laboratory, where they would be promptly tested and a report sent to the physician and a duplicate to the local board of health. Of course it would be necessary for the local board to grant tests only under conditions similar to those employed by the laboratory or District Health Officers.

2. *Standardization of the Wassermann Test in Massachusetts.* — The laboratory wishes to co-operate with any private or public laboratory in effecting a uniform standard for Wassermann examinations. At present a friendly co-operation exists between the State Wassermann Laboratory and the laboratories of the Massachusetts General Hospital and the Boston city board of health, whereby the standards and materials are practically identical.

3. *Investigation.* — By the method of filing employed, the history of each case may be followed during the residence of the patient in the institution; also in the majority of instances the case histories of patients from private physicians may be studied. It is possible from these records to contribute toward a broader study of the diagnosis, epidemiology and treatment of all types of syphilis.

At this time investigation is being carried on with regard to the employment of certain technical methods, with the idea of increasing the accuracy of our technique. This investigation was stimulated by a recent trip of the assistant director to New York, where a study was made of the methods employed in the city board of health, the Rockefeller Institute, the Presbyterian Hospital, the Mt. Sinai Hospital, and the Vanderbilt clinic at Columbia University.

Special work is also being carried on in connection with the State Board of Insanity, which includes a titration of positive spinal fluids, with the hope that some light may be thrown upon the differential diagnosis of the various types of syphilis of the central nervous system.

MEANING TO PUBLIC HEALTH.

The prompt recognition and treatment of syphilis is a public health problem of the first importance. It means a decrease in the incidence of those obstinate late manifestations of the disease which affect the heart, the blood vessels, the brain and spinal cord, the results of which are usually serious and often incurable, or may only be relieved after great suffering and expense to the patient, his family or the Commonwealth, if he becomes a public charge. It means a decrease in the number of miscarriages and stillbirths, and in the congenital syphilitics who either die early or are often greatly handicapped constitutionally. It prevents in many cases needless major surgical operations by correctly diagnosing a syphilitic condition. In all of these

instances a correct Wassermann test gives larger value than the sum total of all other methods used in the diagnosis of the disease.

A few examples are added to illustrate the foregoing: general paresis is by far the most important psychosis affecting both sexes during middle and later life, and its early diagnosis is of the greatest social significance. Consider as a victim of this disease a manufacturer or a locomotive engineer or conductor, who has within his control the lives of many persons, and the diagnosis becomes tremendously important. If not promptly recognized as being afflicted with this form of syphilis, the former might ruin a successful business, with the loss of work to many employees, or the latter might fail to carry out properly those precautions necessary to safeguard the public in railway transportation. A case similar to the last was recently tested in this laboratory.

In the tuberculous group was a patient with a negative sputum, who was interesting and instructive inasmuch as after two years of residence in one of the State sanatoria for tuberculosis, there was no improvement. Syphilis was discovered and admitted after a positive Wassermann report was rendered. The cost of this one case to the Commonwealth, including the services which he may have rendered to the community, would easily pay for the expense of the laboratory for fully three months. Although the work in the tuberculous group has just begun, there is every reason to believe that there are other instances of unsuspected syphilis equally as striking.

FUTURE DEVELOPMENT.

At the present rate of increase there is no reason why the laboratory should not more than treble its tests during the next year. Furthermore, inasmuch as the same materials may be largely used in performing the gonococcus fixation test, it is suggested that this work be undertaken.

APPROPRIATION.

The laboratory was opened with an inadequate appropriation, and, while it has operated within the amount provided, this has been possible only on the basis of a temporarily reduced salary list.

The present rate of testing is about 1,500 specimens per month. There is a rapidly increasing number from private physicians, which greatly augments the clerical and technical work. To carry on this work adequately, \$6,000 per year is needed for the present.

WILLIAM A. HINTON,

Assistant Director, in Charge of the Wassermann Laboratory.

SUMMARY OF THE ANTITOXIN WORK AT ANTITOXIN AND VACCINE LABORATORY.

The horses used in the production of diphtheria antitoxin were treated from December, 1914, to June, 1915, with subcutaneous injections of diphtheria toxin at daily, five-day and ten-day intervals, depending on the system producing the most potent serum; the immunized animals were bled once in twenty-four days. In June, 1915, the interval of bleeding was changed to twice a month or every fourteen days, and the system of toxin injections was changed to three injections in seven days, followed by a rest of a like period before tapping.

Thus, by increasing the number of bleedings, the serum production has been raised 60 per cent., and this has helped materially in obtaining the antitoxin necessary to supply the increased demand during the past year. With the exception of moderate losses in weight, which in time assume a more or less constant level, and an occasional slight reduction in the percentage volume of the red blood corpuscles and sometimes traces of achromia in a few cells, the horses have stood the treatment well. Horses producing serum of high potency are treated conservatively in regard to the toxin injections, but the bleeding intervals have remained the same in all cases.

Of the horses used in the production of antimeningitis serum, 3 are being immunized as formerly with subcutaneous injections, but the method will be changed as soon as practicable to intravenous injections, and at the time of this writing 1 horse that has proven to be unsuited to diphtheria antitoxin work is being treated with intravenous injections of the meningococcus preparations.

Twenty horses were disposed of during the year as shown in Table No. 2. Of these, 4 horses died, and the autopsy findings were as follows: horse No. 201 died from hemorrhage of the liver, and autopsy showed extensive amyloid degeneration of the liver and kidneys; horse No. 213 died from strangulation of the gut, associated with hemorrhage of the liver and amyloid degeneration of the organs; horse No. 218 died in twenty-four hours after a fall against a sharp corner of a watering trough, and autopsy showed a softened area in

the brain just beneath the fracture, and in the abdominal cavity was found amyloid degeneration of the organs; horse No. 226 died as a result of a rupture of the diaphragm, following a kick from another horse and a fall to the ground. Of the remainder, 10 were disposed of by bleeding and 6 by exchange for other horses or by return to the original owners without cost to the laboratory.

The call for diphtheria antitoxin during the past year was greatly increased over that of last year and all previous years, but with the aid of 2 horses giving serum of high potency and by producing more globulin antitoxin by concentration than formerly and in this way raising the strength of much of the serum of low potency, we have been able to supply the demand. The strength of the antitoxin sent out for general distribution averaged 312.5 units per cubic centimeter in the 3,000-unit packages, 300 units per cubic centimeter in 1,500-unit packages and 250 units in 750-unit packages. The average strength of the antitoxin sent to the Boston City Hospital was 216 units per cubic centimeter, and, for convenience in the work of the hospital, the serum was put up in bottles of 12,000 units each.

With the changes in the treatment of the horses, larger quantities of diphtheria toxin were needed this year than formerly, and from Dec. 1, 1914, to Nov. 30, 1915, a total of 334 liters was made. The average strength of the toxin, estimated as a minimal lethal dose, was .0044 cubic centimeter for a 250-gram guinea pig.

The stock of diphtheria antitoxin on hand on Nov. 30, 1915, was 723.3 liters, of which the greater part tested from 200 to 275 units per cubic centimeter, and the remainder 300 units per cubic centimeter or over. The stock of antimeningitis serum at the end of the year was 26.7 liters, or more than a year's supply.

Of the 19 horses for diphtheria work, 15 are in actual use and 4 are being immunized. Of the 15 horses in use, 2 are giving about 300 units and one 400 units of antitoxin per cubic centimeter in the serum produced; the remaining 12 horses are producing serum valued at 200 to 250 units of antitoxin per cubic centimeter.

The following tables give the details of the antitoxin work and are self-explanatory: —

TABLE NO. 1. — *Synopsis of Antitoxin Work.*

Number of horses on hand Dec. 1, 1914 (3 antimeningitis, 22 diphtheria),	26
Number of horses acquired Dec. 1, 1914, to Nov. 30, 1915, ...	17
Total, ...	43
Number of horses disposed of from Dec. 1, 1914, to Nov. 30, 1915, .	20
Number of horses in stables Dec. 1, 1915 (4 antimeningitis, 19 antitoxin),	23

Diphtheria Antitoxin.

General distribution:—

Number of 1,000-unit doses distributed in 3,000-unit packages,	129,270	
Number of 1,000-unit doses distributed in 1,500-unit packages,	16,201	
Number of 1,000-unit doses distributed in 750-unit packages,	6,274	
		151,745

To Boston City Hospital:—

Number of 1,000-unit doses distributed in 2,000-unit packages,	460	
Number of 1,000-unit doses distributed in 4,000-unit packages,	35,864	
Number of 1,000-unit doses distributed in 6,000-unit packages,	864	
Number of 1,000-unit doses distributed in 12,000-unit packages,		
ages, ...	14,076	
Number of 1,000-unit doses distributed in 15,000-unit packages,		
ages, ...	945	
		52,209

Grand total, ... 203,954

Number of liters of serum sent to State for general distribution, . . .	452
Number of liters of serum sent to Boston City Hospital, . . .	248

Total, ... 700

Strength:—

Average number of units per cubic centimeter in 3,000-unit packages,	312.47
Average number of units per cubic centimeter in 1,500-unit packages,	300.00
Average number of units per cubic centimeter in 750-unit packages,	250.00
Average number of units per cubic centimeter in packages to Boston City Hospital, ...	216.03

Globulin antitoxin:—

Number of liters of normal serum plus citrate plasma precipitated, . .	598.7
Number of liters of globulin serum produced, ...	138.9
Average number of units per cubic centimeter of globulin serum, . .	435.4

Diphtheria Toxin.

Culture Park No. 8:—

Number of liters of diphtheria toxin in stock Dec. 1, 1914, ...	89
Number of liters of diphtheria toxin made Dec. 1, 1914 to Nov. 30, 1915, ...	334
	423

Number of liters of diphtheria toxin used Dec. 1, 1914, to Nov. 30, 1915, 343

Number of liters of diphtheria toxin in stock Dec. 1, 1915, ... 80

Average strength of diphtheria toxin in minimal lethal doses, 0.0044 cubic centimeter.

TABLE NO. 2. — *Receipt, Cost and Disposition of Horses in Use from Dec. 1, 1914, to Nov. 30, 1915.**On Hand Dec. 1, 1914.*

HORSE NUMBER.	Received.	Cost.	When dis- posed of.	How disposed of.
143, . .	Jan. 26, 1909	\$45, ...	Mar. 19, 1915	Chloroformed and bled.
165, . .	Apr. 29, 1910	Gift of M. M. Herbert, . .	Apr. 20, 1915	Chloroformed and bled.
185, . .	May 29, 1911	\$59, ...	- -	- -
196, . .	Nov. 3, 1911	\$65, ...	May 7, 1915	Chloroformed and bled.
201, . .	Dec. 29, 1911	\$46, ...	Aug. 1, 1915	Died.
204, . .	Feb. 23, 1912	\$40, ...	Dec. 4, 1914	Chloroformed and bled.
213, . .	Jan. 3, 1913	From Metropolitan Water Works,	Oct. 18, 1915	Died.
216, . .	Feb. 19, 1913	\$35, ...	- -	- -
218, . .	Oct. 27, 1913	\$75, ...	Oct. 13, 1915	Died.
219, . .	Nov. 1, 1913	\$60, ...	Aug. 13, 1915	Chloroformed and bled.
224, . .	May 21, 1914	\$115, ...	- -	- -
225, . .	May 21, 1914	\$98.50, ...	Jan. 13, 1915	Exchanged.
226, . .	May 28, 1914	\$62.50, ...	Mar. 14, 1915	Died.
227, . .	June 3, 1914	\$75, ...	Jan. 26, 1915	Exchanged.
228, . .	June 3, 1914	\$116, ...	Feb. 5, 1915	Chloroformed and bled.
229, . .	June 10, 1914	\$112.50, ...	- -	- -
231, . .	July 8, 1914	\$57, ...	- -	- -
232, . .	July 15, 1914	\$75, ...	- -	- -
233, . .	Aug. 11, 1914	From Metropolitan Park Com- mission.	- -	- -
234, . .	Oct. 2, 1914	\$50, ...	Aug. 20, 1915	Chloroformed and bled.
235, . .	Oct. 23, 1914	Gift of Dr. E. P. Joslin, . .	- -	- -
236, . .	Nov. 5, 1914	Gift of Dr. and Mrs. R. W. Lovett.	Sept. 24, 1915	Chloroformed and bled.
237, . .	Nov. 9, 1914	\$60, ...	- -	- -
238, . .	Nov. 9, 1914	\$65, ...	- -	- -
239, . .	Nov. 9, 1914	\$65, ...	- -	- -
241, . .	Nov. 11, 1914	\$115, ...	- -	- -

TABLE No. 2 — *Concluded.**Acquired after Dec. 1, 1914.*

HORSE NUMBER.	Received.	Cost.	When disposed of.	How disposed of.
243, . .	Dec. 9, 1914	From Metropolitan Park Commission.	- -	- -
244, . .	Dec. 9, 1914	From Metropolitan Park Commission.	- -	- -
245, . .	Dec. 24, 1914	\$60, ...	Sept. 13, 1915	Exchanged.
246, . .	Jan. 13, 1915	\$59, ...	July 22, 1915	Chloroformed and bled.
247, . .	Feb. 2, 1915	\$65, ...	May 28, 1915	Chloroformed and bled.
248, . .	Mar. 6, 1915	- -	Mar. 12, 1915	Returned to owner.
249, . .	Apr. 5, 1915	From Boston Police Department,	- -	- -
250, . .	Apr. 5, 1915	From Boston Police Department,	- -	- -
251, . .	Apr. 20, 1915	From Metropolitan Park Commission.	- -	- -
252, . .	Apr. 20, 1915	From Metropolitan Park Commission.	- -	- -
253, . .	June 9, 1915	\$50, ...	- -	- -
254, . .	Aug. 14, 1915	From Boston Police Department,	- -	- -
255, . .	Oct. 19, 1915	- -	Nov. 30, 1915	Returned to owner.
256, . .	Oct. 23, 1915	\$65, ...	- -	- -
257, . .	Nov. 11, 1915	- -	Nov. 30, 1915	Shot by order of owner.
258, . .	Nov. 11, 1915	\$50, ...	- -	- -
259, . .	Nov. 15, 1915	Gift of C. H. Hastings, Lynn, .	- -	- -

TABLE No. 3. — *Operations on Horses from Dec. 1, 1914, to Nov. 30, 1915.*

HORSE NUMBER.	Anti-toxin Value in Units per Cubic Centimeter at Last Test.	BLOOD DRAWN IN CUBIC CENTIMETERS.				Number of Cubic Centimeters Serum Yield.	Per Cent. Serum Yield.	Number of Cubic Centimeters Citrate Plasma Yield.	Per Cent. Citrate Plasma Yield.
		Numbers of Tappings.	Number of Cubic Centimeters into Jars.	Number of Cubic Centimeters into 10 Per Cent. Sodium Citrate.	Total Cubic Centimeters.				
143, . .	225	86-91	42,000	34,000	76,000	17,650	42.0	22,100	65.0
165, . .	200	66-72	30,000	27,000	57,000	11,625	38.7	19,500	71.4
196, . .	200	42-48	-	90,800	90,800	-	-	52,100	57.3
201, . .	225	42-51	57,600	14,400	72,000	24,425	42.4	11,500	79.8
204, . .	225	39	-	36,800	36,800	-	-	28,400	77.1
213, . .	325	27-44	107,400	-	107,400	46,300	43.0	-	-
216, . .	200	24-43	120,500	-	120,500	53,676	44.5	-	-
218, . .	225	15-30	84,000	12,600	96,600	35,375	42.1	9,700	76.9

TABLE No. 3—*Concluded.*

HORSE NUMBER.	Anti- toxin Value in Units per Cubic Centi- meter at Last Test.	BLOOD DRAWN IN CUBIC CENTIMETERS.				Number of Cubic Centi- meters Serum Yield.	Per Cent. Serum Yield.	Number of Cubic Centi- meters Citrate Plasma Yield.	Per Cent. Citrate Plasma Yield.
		Numbers of Tap- pings.	Number of Cubic Centi- meters into Jars.	Number of Cubic Centi- meters into 10 Per Cent. Sodium Citrate.	Total Cubic Centi- meters.				
219, . . .	200	13-26	90,000	48,400	138,400	43,225	48.2	40,300	83.2
226, . . .	150	4-7	24,800	—	24,800	11,700	47.1	—	—
228, . . .	150	4-7	—	67,950	67,950	—	—	44,500	62.2
229, . . .	200	4-23	77,900	72,600	150,500	30,425	39.0	51,650	71.1
231, . . .	200	4-23	63,100	72,000	135,100	24,325	38.5	51,900	71.9
233, . . .	400	3-21	120,500	—	120,500	46,800	38.8	—	—
234, . . .	225	1-14	72,000	39,500	111,500	23,500	32.6	23,800	62.5
235, . . .	225	1-15	94,600	—	94,600	40,900	43.2	—	—
236, . . .	250	1-13	73,400	30,000	103,400	25,550	34.8	21,350	71.1
238, . . .	225	1-15	100,000	—	100,000	35,050	35.0	—	—
239, . . .	250	1-15	115,300	—	115,300	44,775	38.8	—	—
241, . . .	200	1-15	117,500	—	117,500	52,025	44.2	—	—
243, . . .	225	1-14	95,200	—	95,200	34,000	35.7	—	—
244, . . .	325	1-16	104,000	—	104,000	40,850	39.2	—	—
246, . . .	150	1	—	48,400	48,400	—	—	32,600	67.3
250, . . .	225	1-11	—	61,200	61,200	—	—	38,400	62.7
249, . . .	325	1-10	58,400	—	58,400	22,625	39.0	—	—
251, . . .	200	1-4	—	25,200	25,200	—	—	16,500	65.4
252, . . .	200	1-7	—	32,400	32,400	—	—	21,600	66.6
253, . . .	200	1-2	—	12,600	12,600	—	—	8,700	69.0
Totals,	—	—	1,648,200	725,850	2,374,050	664,800	40.3 ¹	494,600	60.7 ¹

¹ Average.*Operations on Antimenigitis Horses from Dec. 1, 1914, to Nov. 30, 1915.*

HORSE NUMBER.	Number of Tappings.	Number of Cubic Centi- meters of Blood drawn.	Number of Cubic Centimeters Serum Yield.
185, ...	9-13	30,100	11,925
224, ...	1-3	24,900	9,150
232, ...	1-3	18,000	5,675
Totals, ...	—	73,000	26,750

TABLE No. 4. — *General Summary of Production and Distribution, 1914-15.*
Diphtheria Antitoxin.

Number of liters of diphtheria antitoxin on hand Dec. 1, 1914, . . .	627.6
Number of liters of diphtheria antitoxin produced Dec. 1, 1914, to Nov. 30, 1915: —	
Normal serum, ...	664.8
Globulin serum, ...	138.9
Total, ...	803.7
Number of liters of diphtheria antitoxin available for use during year, . . .	1,431.3
Number of liters of diphtheria antitoxin filled in and distributed Dec. 1, 1914, to Nov. 30, 1915, ...	708.0
Number of liters of diphtheria antitoxin on hand Dec. 1, 1915, . . .	723.3

Antimeningitis Serum.

	Cubic Centimeters.
Stock on hand Dec. 1, 1914, ...	16,345
Produced from Dec. 1, 1914, to Nov. 30, 1915, ...	26,750
Returned serum, reserve, etc., ...	1,685
Total, ...	44,780
Amount distributed from Dec. 1, 1914, to Nov. 30, 1915, ...	17,105
Amount in stock Dec. 1, 1915, ...	26,675

Test Animals Dec. 1, 1914, to Nov. 30, 1915.

Number of guinea pigs raised at laboratory, ...	498
Number of guinea pigs purchased, ...	227
Number of guinea pigs used during year, ...	725

TABLE No. 5. — *Distribution of Diphtheria Antitoxin from Dec. 1, 1914, to Nov. 30, 1915.*
Number of 1,000-unit Doses of Diphtheria Antitoxin distributed per Month in Different Sized Packages.

YEAR.	Month.	GENERAL DISTRIBUTION.			TO BOSTON CITY HOSPITAL.					Grand Total Number of 1,000-unit Doses.
		750 Units.	1,500 Units.	3,000 Units.	2,000 Units.	4,000 Units.	6,000 Units.	12,000 Units.	15,000 Units.	
1914, ...	December, ...	600	1,500	13,200	-	6,272	-	-	-	21,572
1915, ...	January, ...	600	1,200	10,800	-	5,488	-	-	-	18,088
1915, ...	February, ...	750	1,800	12,000	-	4,704	-	-	-	19,254
1915, ...	March, ...	750	900	13,890	-	5,488	-	-	-	21,028
1915, ...	April, ...	450	1,201	10,224	-	5,488	-	-	-	17,363
1915, ...	May, ...	300	900	9,000	-	7,056	-	-	-	17,256
1915, ...	June, ...	300	600	7,200	276	1,308	252	2,736	945	13,677
1915, ...	July, ...	300	900	7,200	184	-	168	2,376	-	11,128
1915, ...	August, ...	300	1,200	7,860	-	-	156	3,420	-	12,936
1915, ...	September, ...	724	1,800	10,200	-	-	-	1,704	-	14,428
1915, ...	October, ...	450	2,100	11,496	-	-	288	2,124	-	16,458
1915, ...	November, ...	750	2,100	16,200	-	-	-	1,716	-	20,766
Totals, ...		6,274	16,201	129,270	480	35,864	864	14,076	945	203,954

TABLE No. 6. — *Distribution of Diphtheria Antitoxin.*
Number of Bottles distributed per Month in the Different Sized Packages.

YEAR.	Month.	GENERAL DISTRIBUTION.				TO BOSTON CITY HOSPITAL.					Grand Total Number of Bottles.
		750 Units.	1,500 Units.	3,000 Units.		2,000 Units.	4,000 Units.	6,000 Units.	12,000 Units.	15,000 Units.	
1914, ...	December, ...	800	1,001	4,400		-	1,568	-	-	-	7,769
1915, ...	January, ...	800	800	3,600		-	1,372	-	-	-	6,572
1915, ...	February, ...	1,000	1,200	4,000		-	1,176	-	-	-	7,376
1915, ...	March, ...	1,000	600	4,630		-	1,372	-	-	-	7,602
1915, ...	April, ...	601	801	3,408		-	1,372	-	-	-	6,182
1915, ...	May, ...	400	600	3,000		-	1,764	-	-	-	5,764
1915, ...	June, ...	400	400	2,400		138	342	42	228	63	4,013
1915, ...	July, ...	400	600	2,400		92	-	28	198	-	3,718
1915, ...	August, ...	400	800	2,620		-	-	26	285	-	4,131
1915, ...	September, ...	966	1,200	3,400		-	-	-	142	-	5,708
1915, ...	October, ...	600	1,400	3,832		-	-	48	177	-	6,057
1915, ...	November, ...	1,000	1,400	5,400		-	-	-	143	-	7,943
Totals, ...		8,367	10,802	43,090		230	8,966	144	1,173	63	72,835

TABLE NO. 7. — *Distribution of Antimeningitis Serum from Dec. 1, 1914, to Nov. 30, 1915.*

YEAR.	Month.	Doses (15 Cubic Centimeters each) sent out.
1914, ...	December, ...	100
1915, ...	January, ...	50
1915, ...	February, ...	150
1915, ...	March, ...	100
1915, ...	April, ...	150
1915, ...	May, ...	50
1915, ...	June, ...	100
1915, ...	July, ...	200
1915, ...	August, ...	—
1915, ...	September, ...	50
1915, ...	October, ...	50
1915, ...	November, ...	100
Total, ...		1,100

SUMMARY OF THE WORK OF PROPAGATING VACCINE VIRUS AND TYPHOID PROPHYLACTIC.

Special Tests for Safeguarding the Purity of Vaccine Virus.

As a safeguard for the purity and potency of the vaccine, the following tests are made for each lot before its distribution: —

1. To determine the *number of bacteria*, one-fourth cubic centimeter of vaccine is shaken with a measured amount of normal salt solution; 1 cubic centimeter of this is added to melted agar and "plated." After two days in the incubator, the colonies which have developed on the plate are counted, and the number of bacteria per cubic centimeter calculated. A microscopic examination is also made of representative colonies, to determine their morphologic characters.

2. *The effect of vaccine virus on a guinea pig* is determined by injecting one-fourth cubic centimeter of the finished product subcutaneously in the region of the abdomen. The animal is then observed at frequent intervals for a month, or until the subcutaneous swelling, produced by the bacteria in the vaccine, has disappeared. This test is supplementary to the three other tests against tetanus and other pathogenic micro-organisms.

3. *The presence or absence of Bacillus Welchii* in vaccine is shown by

adding one-fourth cubic centimeter to a tube of sterile milk and incubating. This is observed during forty-eight hours for the characteristic "stormy fermentation" and odor of butyric acid.

4. Three different tests are made for the tetanus bacillus as follows: (a) one-fourth cubic centimeter of vaccine is added to a fermentation tube containing unfermented bouillon and sterile (guinea pig) tissue; (b) one-fourth cubic centimeter of vaccine is added to a fermentation tube containing unfermented bouillon to which has been added 1 per cent. dextrose; (c) one-fourth cubic centimeter of vaccine is added to a second 1 per cent. dextrose-bouillon tube, which is then steamed for an hour (Arnold sterilizer) at 65° to 70° C.

These three fermentation tubes are then placed at a temperature of 37° C. for nine days, and observed during this period in regard to gas production, surface growth and degree of cloudiness of the fluid. Stained preparations are made from the sediment and examined under the microscope for anærobic spores.

On the ninth day of incubation, a mouse is inoculated from each tube, being given a subcutaneous injection of one-fourth cubic centimeter of the culture. During the first forty-eight hours after inoculation, the mouse is watched carefully for signs of tetanus. Further observation of the animal is made for a month.

5. If the above tests show the vaccine to be suitable for use, *potency tests* are made on children supplemented by similar tests on calves. Careful records are kept concerning the special characters of the "take" in each case. No vaccine is sent out which does not comply with the requirements of all of the tests.

The following tables show the details of the vaccine and typhoid work: —

VACCINE, 1915.

TABLE NO. 1. — *Calves inoculated and Vaccine produced, Dec. 1, 1914, to Nov. 30, 1915.*

WHEN RECEIVED.	Number of Calves.	Laboratory Number.	YIELD OF VACCINE.	
			Cubic Centimeters.	One-sixtieth Cubic Centimeter Doses.
1914.				
December 2, ...	1	462	80	4,800
1915.				
January 6, ...	1	463	70	4,200
January 12, ...	2	464	70	4,200
		465	73	4,380
January 26, ...	2	466	92 ¹	5,520
		467	55 ¹	3,300
February 19, ...	1	468	95	5,700

¹ Vaccine not used.

TABLE No. 1 — *Concluded.*

WHEN RECEIVED.	Number of Calves.	Laboratory Number.	YIELD OF VACCINE.	
			Cubic Centimeters.	One-sixtieth Cubic Centi- meter Doses.
1915.				
March 6, ...	1	469	-	-
March 30, ...	1	470	-	-
April 23, ...	2	{ 471 472 473	- 65 ¹ 100	- 3,900 6,000
May 14, ...	3	{ 474 475 476	110 115 80	6,600 6,900 4,800
May 28, ...	3	{ 477 478 479	60 85 -	3,600 5,100 -
June 14, ...	3	{ 480 481 482	64 78 75	3,840 4,680 4,500
July 30, ...	3	{ 483 484 485	97 100 85	5,820 6,000 5,100
August 14, ...	3	{ 486 487 488	95 95 90	5,700 5,700 5,400
September 9, ...	3	{ 489 490 491	70 100 103	4,200 6,000 6,180
October 1, ...	2	{ 492	117	7,020
Totals, ...	31	-	2,319	139,140

¹ Vaccine not used.TABLE No. 2. — *Summary of Work by Months.*

MONTH.	Number of Calves inoculated.	Doses of Vaccine produced.	Doses of Vaccine sent out.	Doses returned unused.	Doses used.
1914.					
December, ...	1	4,800	3,995	339	3,656
1915.					
January, ...	3	12,780	3,275	199	3,076
February, ...	2	8,820	2,540	27	2,513
March, ...	2	5,700	4,008	96	3,912
April, ...	1	-	4,565	391	4,174
May, ...	5	23,400	10,440	225	10,215
June, ...	6	22,020	5,080	34	5,046
July, ...	-	-	7,075	39	7,036
August, ...	3	16,320	27,066	277	26,789
September, ...	6	32,100	23,806	181	23,625
October, ...	2	13,200	8,672	647	8,025
November, ...	-	-	4,400	663	3,737
Totals, ...	31	139,140	104,922	3,118	101,804

TABLE NO. 3. — *Autopsies on Vaccine Calves, 1915.*

DATE OF AUTOPSY.	Number of Calf.	Autopsy Notes.	Remarks.
1914.			
December 9, . . .	462	Normal, ...	- -
1915.			
January 14, . . .	463	Normal, ...	- -
January 27, . . .	464	Normal, ...	- -
January 27, . . .	465	Normal, ...	- -
February 10, . . .	466	Normal, ...	Vaccine not used.
February 10, . . .	467	Several small pneumonic areas; otherwise normal,	Vaccine not used.
March 3, ...	468	Normal, ...	- -
March 23, ...	469	Erosions on lips and tongue, ...	Vaccine not used.
April 14, ...	470	Erosions on lips and in stomach; tuberculous mediastinal glands.	Vaccine not used.
May 4, ...	471	Small papules on lips, ...	Vaccine not used.
May 11, ...	472	Two small areas of pneumonia; subcutaneous swelling on abdomen.	Vaccine not used.
May 26, ...	473	Normal, ...	- -
May 26, ...	474	Normal, ...	- -
May 26, ...	475	Normal, ...	- -
June 9, ...	476	Normal, ...	- -
June 9, ...	477	Normal, ...	- -
June 9, ...	478	Normal, ...	- -
June 26, ...	479	Calf died of gastroenteritis, ...	No vaccine.
June 28, ...	480	Normal, ...	- -
June 28, ...	481	Normal, ...	- -
August 11, ...	482	Normal, ...	- -
August 11, ...	483	Normal, ...	- -
August 18, ...	484	Normal, ...	- -
September 8, ...	485	Normal, ...	- -
September 8, ...	486	Normal, ...	- -
September 8, ...	487	Normal, ...	- -
September 22, ...	488	Normal, ...	- -
September 22, ...	489	Normal, ...	- -
September 22, ...	490	Normal, ...	- -
October 13, ...	491	Normal, ...	- -
October 13, ...	492	Normal, ...	- -

TABLE NO. 4. — *General Summary.*

Number of calves inoculated, ...	31
Vaccine virus produced (cubic centimeters), ...	2,319
Vaccine virus produced (one-sixtieth cubic centimeter doses), ...	139,140
Number of capillary tubes sent out, ...	100,922
Vaccine virus sent out in bulk (one-sixtieth cubic centimeter doses), ...	4,000
Total doses sent out, ...	104,922
Doses returned, ...	3,118
Approximate amount (doses) used, ...	101,804
Amount of vaccine (cubic centimeters) on hand Dec. 1, 1914, ...	483
Amount produced during the year, ...	2,319
Allowance for dilution of vaccine, ¹	235
Total, ...	3,037
Amount reserved, including seed, ...	261
Amount for distribution, ...	2,776
Amount sent out, ...	1,749
Amount (cubic centimeters) on hand Nov. 30, 1915, ...	1,027
Amount (one-sixtieth cubic centimeter doses) on hand Nov. 30, 1915, ...	61,620

¹ Owing to the "thickness" of the vaccine as originally prepared, it is diluted about 15 per cent. before filling into capillary tubes.

TABLE NO. 5.—*Amount of Typhoid Prophylactic prepared and distributed December, 1914, to November, 1915, inclusive.*

MONTH.	Amount prepared (Cubic Centimeters).	Ampoules and Doses in Bulk (1 Cubic Centimeter) sent out.	Ampoules returned.
1914.			
December, ...	2,000	900	56
1915.			
January, ...	—	400	59
February, ...	1,800	500	—
March, ...	1,800	1,649	171
April, ...	6,000	3,676	126
May, ...	4,000	6,005	27
June, ...	8,000	7,675	18
July, ...	4,000	1,650	15
August, ...	—	1,500	35
September, ...	3,600	2,100	23
October, ...	3,600	3,100	101
November, ...	3,600	2,200	27
Totals, ...	38,400	31,355	658

Summary.

Amount (cubic centimeters) on hand Dec. 1, 1914, ...	2,066
Amount produced Dec. 1, 1914, to Nov. 30, 1915, ...	38,400
Amount for use during the year, ...	40,466
Amount sent out during the year, ...	31,355
Balance, ...	9,111
Amount not used, ...	6,011
Amount on hand Nov. 30, 1915, ...	3,100

HERBERT R. BROWN,

Assistant Director, in Charge of Antitoxin and Vaccine Laboratory.

DIVISION OF HYGIENE.

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DIVISION OF HYGIENE.

DIRECTOR, SELSKAR M. GUNN.

Dr. ALLAN J. McLAUGHLIN, *Commissioner of Health.*

SIR:— I have the honor to submit the following report of the
Division of Hygiene for the year ending Nov. 30, 1915.

Respectfully submitted,

SELSKAR M. GUNN,

Director.

FIRST REPORT OF THE DIVISION OF HYGIENE.

The Division of Hygiene of the State Department of Health was created on May 1, 1915, by vote of the Public Health Council, and the director of the Division was appointed on May 15, 1915, under an arrangement which provided that he should give half his time to the duties of the position.

Miss May B. Dickinson, who had been working for the Division of Communicable Diseases, was immediately transferred to the new division and later on was given the title of field supervisor of the Division of Hygiene. On Aug. 10, 1915, Mr. L. W. Feezer was appointed assistant director on half-time. In the late summer Miss M. H. P. Bridges was appointed temporary health instructor.

As the Department had never undertaken any regular work in health education the Division had no precedent to follow and had to create its activities.

INFANT MORTALITY.

One of the chief health problems that first received the attention of the Division was infant mortality. While there has been an undoubted decrease in the infant mortality rate for the State, as shown by the following figures for the six years ending 1914, it is obvious that many infants now succumb whose lives could be saved under the best of conditions.

Infant Mortality Statistics of the Commonwealth of Massachusetts.¹

YEAR.	Total Births.	Deaths under One Year.	Infant Mortality Rate.
1909, ...	84,039	10,693	127.2
1910, ...	86,539	11,499	132.9
1911, ...	88,327	10,543	119.4
1912, ...	89,882	10,472	116.5
1913, ...	91,644	10,086	110.1
1914, ...	93,399	9,894	105.9

¹ Figures in this table taken from records of the Secretary of the Commonwealth.

As no information was available of the infant mortality rate for each community in the State, it was considered essential that a special statistical study be made of infant mortality in each of the 353 cities and towns of the State. This information was deemed necessary so that the Division might know where educational work was most needed. The information could only be obtained by going over all the death certificates and tabulating those under one year of age. This was done for each community for the six years ending 1914. The information gathered is of the greatest value, and a special report on the subject is now being prepared. This work was done while the Division was getting material ready for its lecture service and infant welfare exhibit.

A special house-to-house investigation was made in Lowell in 284 homes in which an infant had died during the previous year.

LECTURE SERVICE.

One of the recognized channels of health education is by means of health lectures. With the co-operation of the Division of Communicable Diseases thirteen health lectures were prepared, and in each instance a collection of lantern slides obtained.

A list of these lectures follows: —

- Cancer and the Wear and Tear Diseases of Adult Life.
- Child Welfare.
- Health on the Farm.
- How to Keep Well.
- Insects and Disease.
- Man and the Microbe.
- Milk.
- Oral Hygiene.
- Public Health Nurse.
- Pure and Clean Food.
- Quackery and the Patent Medicine Evil.
- School Hygiene.
- Tuberculosis.

A circular describing the lecture service was prepared and distributed to boards of health, women's clubs and other organizations. The Division also purchased electric and gas stereopticons.

A few lectures were given in May, June, July and August, but the regular winter season lecture service did not commence until October. The following table shows the lectures given by months: —

May, ...	6	September, ...	0
June, ...	7	October, ...	25
July, ...	10	November, ...	44
August, ...	14	Total, ...	106

There is a growing demand for these lectures, and the Division has booked over 100 lectures for a single month during the coming winter. These lectures were given in the following communities: —

Amherst, ...	6	Lowell, ...	1
Arlington, ...	4	Marion, ...	1
Bellingham, ...	1	Medfield, ...	1
Beverly, ...	1	Milton, ...	1
Billerica, ...	2	Northampton, ...	1
Boston, ...	25	North Adams, ...	2
Bourne, ...	1	Norwood, ...	1
Braintree, ...	1	Pittsfield, ...	1
Bridgewater, ...	1	Quincy, ...	9
Brimfield, ...	1	Rockland, ...	1
Brockton, ...	1	Salem, ...	1
Cambridge, ...	5	Southwick, ...	1
Chicopee, ...	1	Springfield, ...	3
Concord, N. H., ...	1	Uxbridge, ...	2
Dighton, ...	1	Wakefield, ...	1
Fairhaven, ...	3	Watertown, ...	1
Gloucester, ...	1	Wayland, ...	9
Hanover, ...	1	Wellesley, ...	2
Hanson, ...	1	Westborough, ...	1
Holyoke, ...	3	Wilmington, ...	1
Hubbardston, ...	1		
Hull, ...	2	Total, ...	106
Lee, ...	1		

MOVING PICTURES.

The Division also purchased eight moving picture films dealing with health topics. These films cover the following subjects: —

"Bringing It Home,"	Child Welfare.
"The Long vs. the Short Haul,"	Child Welfare.
"The Temple of Moloch,"	Tuberculosis.
"The Price of Human Lives,"	Tuberculosis.
"In His Father's Footsteps,"	Typhoid Fever.
"Toothache,"	Oral Hygiene.
"The Price of Thoughtlessness,"	Accidents.
"Fly Danger."	

There is no question of the value of films as a bait to produce audiences. The health films that are now available, with a few exceptions, do not seem to be especially good, as the health lesson contained in them is subordinated to the "story." There is, undoubtedly, a great opportunity for the development of good health films.

With the co-operation of the Brockton board of health the Division showed films on a Sunday afternoon and evening at one-hour performances to six audiences aggregating approximately 4,500 people.

In Arlington, in conjunction with the board of health, the superintendent of schools and the medical inspector of schools, special programs of lectures illustrated with moving pictures and lantern slides were given to the school children. These lectures were given during school hours, the children being marched in grades from their school rooms by their teachers. In this manner it was possible for the Department to reach all the public school children in one morning, and, as they were assembled according to ages, to grade the talks to the mental development of the children. Every one was pleased with this experiment. The impossibility of measuring the benefits derived from such health education is regrettable. That it must have some effect is obvious, but it needs to be followed up by the school authorities in a vigorous and interesting manner.

EXHIBITS.

Realizing the magnitude of the infant morbidity and mortality problems, it was decided to construct an infant welfare exhibit. The exhibit consists of twenty panels, 3 by 6 feet. The panels were carefully designed and made as attractive as possible with enlarged photographs and sketches. They cover practically all of the important points in connection with the subject.

In addition to the panels the exhibit also includes a complete infant outfit of clothes, feeding bottles, pasteurizer and refrigerator.

The exhibit was first shown at Quincy during the week of November 8. During the week of November 15 the exhibit was shown in the new wing of the State House in connection with the city and town planning exhibit.

That such an exhibit is desired by the communities of the State is evidenced by the demand for it. It seems probable that it will be continually on the road until the advent of hot weather. Additional exhibits are needed. The Department should have a small general exhibit for rural sections, and an exhibit on cancer and the wear and tear diseases of adult life would undoubtedly prove popular.

HEALTH WEEKS.

Health weeks are becoming popular and are, undoubtedly, of great value. It is impossible to state to what extent the advent of health activities on the part of the State Department of Health has stimulated communities to hold health weeks, but it is fair to assume that our work has been a factor of importance in this connection.

SCHOOL HYGIENE.

This Division, with the co-operation of the Division of Communicable Diseases, prepared a *questionnaire* with regard to medical inspection of schools, the sanitation of school buildings and the teaching of hygiene in the schools. The District Health Officers by personal visits collected the information called for from each community in the State. The tabulation of the results is now in progress, and it should prove of great value by giving us exact information on these vital topics.

PUBLICATIONS.

The Division has had charge of the publication of the Monthly Bulletin of the Department. Efforts have been made to improve it by making it of more interest. The saving of space by printing tables in a more economical manner has been effected. The circulation has also been increased. The Bulletin now goes to approximately 10,000 persons every month. This includes all the physicians in the State.

A special pamphlet on "Mosquitoes and Malaria" was issued during the summer.

Much time has been spent by members of this Division in the preparation of a "baby book." The book, which will not be ready for distribution until next month, is entitled "The Baby and You." It contains thirty-four pages, and, besides having a two-colored cover, is illustrated with twenty-eight pen-and-ink sketches prepared by Miss E. M. Ford, clerk of this Division. It is planned to distribute this book, already enclosed in an envelope, to all local boards of health who will mail it to all mothers in their communities as soon as possible after the report of births.

There is a great need for much popular health literature. At the present time the Department is unable to distribute such educational pamphlets on account of lack of funds for this purpose. It is hoped that in the future it may be possible to prepare and distribute simply written, attractive pamphlets dealing with many matters of health significance.

CONCLUSION.

The Commissioner in his report has very succinctly stated the needs for health education. No one who has followed the development of preventive medicine during the last decade can deny the need for such work. We are rapidly reaching a point in many parts of our country where public health work can be considered as excellent. We have an ever-increasing number of competent health officials, increased budgets for health departments and excellent public health administration. Nevertheless, in communities so happily situated, we still find great quantities of communicable disease, and, of course, no diminution in the so-called wear and tear diseases of adult life. Further progress is not so much a question of health administration as it is of health education. The difficulties are great and only time will allow us to measure the results.

REPORT OF THE BOARD OF THE STATE
EXAMINERS OF PLUMBERS.

REPORT OF THE STATE EXAMINERS OF PLUMBERS.

Dr. ALLAN J. McLAUGHLIN, *Commissioner of Health.*

SIR: — The State Examiners of Plumbers have the honor to submit the following report of their affairs for the year ending Nov. 30, 1915: —

EXAMINATIONS.	Examined.	Passed.	Refused.
Boston, Dec. 5, 1914, ...	48	8	40
Lowell, Dec. 19, 1914, ...	22	7	15
Boston, Jan. 2, 1915, ...	65	20	45
Pittsfield, Jan. 16, 1915, ...	24	6	18
Boston, Feb. 6, 1915, ...	100	27	73
Springfield, Feb. 20, 1915, ...	53	13	40
Boston, March 6, 1915, ...	102	25	77
Fall River, March 20, 1915, ...	39	9	30
Boston, April 3, 1915, ...	93	24	69
Worcester, April 17, 1915, ...	42	10	32
Boston, May 1, 1915, ...	72	25	47
Lowell, May 15, 1915, ...	22	6	16
Boston, June 5, 1915, ...	83	23	60
Pittsfield, June 19, 1915, ...	26	7	21
Boston, July 3, 1915, ...	85	13	72
Boston, Sept. 4, 1915, ...	94	15	79
Springfield, Sept. 18, 1915, ...	65	10	55
Boston, Oct. 2, 1915, ...	96	13	83
Fall River, Oct. 16, 1915, ...	49	15	34
Boston, Nov. 6, 1915, ...	100	27	73
Worcester, Nov. 20, 1915, ...	28	4	24
Totals, ...	1,310	307	1,003

	Masters.	Journeymen.	Total.
Licenses granted on account of examinations December, 1914, to December, 1915.	68	239	307
Probationary licenses issued during the year, . . .	—	—	9

REGISTRATIONS.	Masters.	Journeyman.
December, 1914, ...	9	20
January, 1915, ...	1	21
February, 1915, ...	9	16
March, 1915, ...	14	40
April, 1915, ...	10	26
May, 1915, ...	20	28
June, 1915, ...	12	20
July, 1915, ...	7	24
August, 1915, ...	5	4
September, 1915, ...	9	12
October, 1915, ...	4	35
November, 1915, ...	6	27
Totals, ...	106	273

Meetings, ... 75	Examinations, ... 21
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FEES RECEIVED.	Paid to the Treasurer of the Commonwealth.
1,310 examination fees, at \$0.50, ...	\$655 00
3 examination fees paid in but examinations not taken, ...	1 50
106 master plumber licenses issued, at \$2, ...	212 00
273 journeyman plumber licenses issued, at \$0.50, ...	136 50
1,707 master plumber renewals, at \$0.50, ...	853 50
3,906 journeyman plumber renewals, at \$0.50, ...	1,953 00
60 back fees for 1911-14, at \$0.50, ...	30 00
	\$3,841 50

For carrying out the Provisions of the Act relative to the Examination of Plumbers.

Appropriations for the year ending Nov. 30, 1915, ...	\$5,200 00
Salary, clerk, ...	\$2,000 00
Wages, second and third examiners, ...	640 00
Traveling expenses, ...	525 37
Express charges, ...	39 59
Printing, ...	347 78
Postage, ...	280 30
Books and stationery, ...	129 12
Plumbers' materials, ...	54 99
Extra services, ...	1,017 00
Cleaning, ...	14 50
Typewriter and office supplies, ...	100 63
Miscellaneous, ...	11 52
	\$5,160 80

Summary of Registrations.

	Masters.	Journeyman.
Certificate holders, ...	504	480
Licenses, year ending May 1, 1916, ...	1,769	2,805
Totals, ...	2,273	3,285

Deceased Plumbers (reported to Examiners).

Masters, ... 14 | Journeyman, ... 11

JAMES C. COFFEY, *Chairman.*

CHARLES R. FELTON.

DAVID CRAIG, *Clerk.*

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